The Politics and Poetics of Coexistence:

Experiments At The Intersection Of Art And Environmental Engineering

by

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The work contained in this thesis has not been previously submitted to meet requirements for an award at this or any other higher education institution. To the best of my knowledge and belief, the thesis contains no material previously published or written by another person except where due reference is made.

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Signature

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Keywords

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Abstract

This research project explores how interdisciplinary art practices can provide ways for questioning and envisaging alternative modes of coexistence between humans and the non-humans who together, make up the environment. As a practice-led project, it combines a body of creative work (50%) and this exegesis (50%). My interdisciplinary artistic practice appropriates methods and processes from science and engineering and merges them into artistic contexts for critical and poetic ends. By blending pseudo-scientific experimentation with creative strategies like visual fiction, humour, absurd public performance and scripted audience participation, my work engages with a range of debates around ecology. This exegesis details the interplay between critical theory relating to these debates, the work of other creative practitioners and my own evolving artistic practice. Through utilising methods and processes drawn from my prior career in water engineering, I present an interdisciplinary synthesis that seeks to promote improved understandings of the causes and consequences of our ecological actions and inactions.

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Supplementary materials are included as files on the disc enclosed. Each work is documented in video and images and instructions are given throughout this text indicating when each work's documentation should be viewed.

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Forward

This project began in 2009 when Australian media artists Dr Keith Armstrong, Leah Barclay and James Muller, together with American-based artist Natalie Jeremijenko and design theorist Tony Fry were awarded the Inter-Arts *ArtLab* grant[1] from the Australian Council for the Arts. Their resulting *Remnant-Emergency ArtLab* (Armstrong, 2010a) aimed to creatively and experimentally respond to specific ecological issues and contexts that were broadly symptomatic of the contemporary environmental crisis. In doing so, the team sought to "create better and more powerful participatory images of what a citizen-led, sustainable world might be" (Armstrong, 2010b). As part of this grant, the host institution, Queensland University of Technology, agreed to award scholarships to three Masters of Art (research) students to collaborate on the project.

As one of these selected Masters students I was expected to both collaborate with the *ArtLab* team and to advance my own research practice. Two of the projects analysed in this thesis, *The Bat-Human Partnership* (2010) and to a lesser extent *The Pollination Service* (2010-11), were developed as collaborative projects alongside the *ArtLab* team. Other works were developed independently, but ultimately contributed to the broad aegis of the *Remnant Emergency ArtLab*, which coincided with my interests in exploring new possibilities for both ecological thought and action.

[1] This special initiative of the Australia Council InterArts Panel is available to interdisciplinary groups of creative practitioners. It funds a program of creative research focused on collaboration, creative risk taking and non-outcome driven research.

Art's ambiguous, vague qualities will help us think things that remain difficult to put into words. Reading poetry won't save the planet. Sound science and progressive social policies will do that. But art can allow us to glimpse beings that exist beyond or between our normal categories.

(Morton, 2010, p. 60)

Introduction

This practice-led research project is an interdisciplinary exploration into our relationship with ecology. It investigates how this relationship materialises in the infrastructures and processes that connect our societies. Ecology describes the mesh of relationships within which all things, both living and non-living, are bound. Although popularly used to describe the biophysical interdependencies between organisms and their surrounds, in this thesis I clarify that these ecologies are in fact inseparable from social, political and cultural ecologies[2]. Through the combination of this exegesis and five artworks, I argue for a re-envisaged, expanded understanding ecology that challenges the concept of 'the environment' as something existing in separation from human society. This understanding of ecology also exists free from the historical concept of 'nature' and its implied allusions to balance, neutrality and mystery.

My professional and scholarly background lies primarily in environmental engineering having trained and worked in this area from 2001-2009. This field is chiefly driven by the need to design processes and infrastructures that define how our societies interface with the 'non-human' – the other living and non-living things with whom we coexist.[3] Yet the everyday practices of engineering, as I experienced them, rarely acknowledged the cultural assumptions that underpin the scope of their operations. With this in mind, this project sets out to examine if new forms of interdisciplinary art practices have the capacity to both shed light on this deficiency and open up new conversations around it. Rather than suggesting practical 'engineering' solutions, I therefore mobilise playful, interactive and engaging arts strategies to explore these shortcomings and potentially illuminate new ways of thinking. I have chosen to engage these issues with art because of its ability to suggest possibilities that lie beyond or between conventional ways of thinking. As

[2] Authors such as Gregory Bateson (1991), Tony Fry (1999) and Timothy Morton (2007, 2010) all understand ecology in this expanded sense.
[3] The term non-human avoids the worst of the natural/artificial and the human/environment binaries that pervade environmental discourse. I use it to describe both biotic and abiotic objects.

such, I present strategies that provide new possibilities for developing a better understanding of our ecology.

For this research project I have developed and produced five artworks, *The Bat-Human Partnership, The Pollination Service, Oceans of Air, Kilowatt Hours* and *Coin-Operated Wetland.*[4] Each work engages with environmental systems through their subject matter, processes and materials. As with much practice–led research, equal emphasis is placed on both process and methodology (Gray, Pirie & Malins, 1995, p. 14), and as such, these works are neither finished nor autonomous objects, but are rather creative experiments inseparable from the debates in which they engage. By mixing methodologies from the disciplines of art, science and engineering these works seek to actively infiltrate the networks of ideas, materials, forms and theories that inform these debates. In them, I carry out information collection and translation, I set up experimental infrastructures and I speculate on institutional structures. Each work is therefore a proposition and a provocation that sets up a tension with the 'status quo' of how cities and communities are typically designed.

RESEARCH BACKGROUND

This research project draws heavily on my previous experience as an environmental engineer working in the field of Water Sensitive Urban Design (WSUD). As an engineer I found myself increasingly frustrated with the predominantly 'end-of-pipe' approach to environmental monitoring, management and design.[5] Environmental engineering is effectively about managing the ecosystemic interfaces of human communities through the deployment of infrastructure systems that either bring materials such as water or electricity into human communities or transfer them out in the form of 'waste'.[6] As the ecological impact of a growing human population increases, these designed interactions

[4] All projects were produced and exhibited between 2010–2011.
[5] I spent significant time working on 'sustainable' water infrastructure for large-scale green field developments being constructed in Western Sydney areas such as Oran Park. My environmental engineering team were contracted to design drainage and water quality treatment systems so that these developments would comply with stormwater development guidelines.
[6] I understand infrastructures to be constructed systems that deliver amenity to human communities; systems that structure interactions between human society and the material world. They include technical systems that provide, for example, water, energy, waste removal, means of communication (such as the telephone and postal service) and access to information (such the Internet or databases).

between the human and non-human environment have become increasingly significant, yet the complex sociocultural assumptions that underlie them are rarely considered. In my experience, daily procedures of environmental engineering were routinely viewed through a narrow technical lens. As I worked on major infrastructures, computational modelling, design, construction and the maintenance of roads, drains, pipes, valves, pollutant traps, dams and channels I became aware that the cultural and social forces that shaped these projects were largely forgotten or ignored.[7] Rational solutions were instead drawn from a dominantly instrumental view of non-humans.

Implicit in such thinking was that non-humans, whether they be water molecules, wetlands or flying foxes are merely tools, resources or problems to be managed or exploited in efficient and cost effective ways. Binaries like nature/culture and science/politics appeared to be staunchly embedded within these conceptions, despite them having been widely unravelled in the humanities by theorists Bruno Latour, Michael Serres and many others. As the fields of science and engineering are complicit in both the production of and response to our unsustainable state of affairs, they must therefore now be critically examined in order to shed light on how we arrived here and to speculate upon new conceptual forms in ecology.

Several recent publications focus on the need to acknowledge the cultural dimensions of engineering.[8] "Engineers need to know a good deal more than merely how to make technical artefacts and technological systems function effectively. They need to be able to combine their technical and scientific knowledge with an understanding of how the wider world operates" (Jamison, Hyldgaard & Botin, 2011,

[7] Due to this this apparent disjuncture, these connections have been historically interrogated through the disciplines of science, technology and society studies (STS), a field that is therefore aligned with the aims of this research. STS researchers, who often come from the social sciences, critically examine processes within science and technology making. A classic text that marks the early beginnings of the study of scientific knowledge production is Thomas Kuhn's (1962) *The Structure of Scientific Revolutions.* The social, cultural, and political conditions around technological innovation has also inspired much literature such as the seminal contributions from Donald MacKenzie such *The Social Shaping of Technology* (MacKenzie and Wajcman, 1985), Bruno Latour's (1982) *Science In Action* and Langdon Winner's (1986) *The Whale and the Reactor*. They amongst many others argue for the social construction of technology, a theory that asserts that technological developments cannot be separated out from their social contexts.

[8] See Jamison, et al. (2011), Baillie (2009) and Fischer (2000) for further discussion of the need for more focus on the cultural conditions around the practice of engineering.

p. 1). In view of this assertion, it is evident that new forms of engagement between science, engineering and the social and cultural spheres are urgently required.

Jamison, et al. (2011) address this absent cultural perspective in engineering by providing a counterpoint to what the authors call the "hubris" – a term used by the ancient Greeks to describe the ambition to 'play god' and transcend limitations imposed by nature (p. 3). This hubris of our modern technological lifestyles is an "unreasonable redirection of nature's causality for human purposes" (Von Wright as cited in Jamison, et al., 2011, p. 3). The hubris of engineering is also something that I experienced firsthand. In order to investigate, experiment, design and build one has to typically subscribe to at least some degree of technological progressivism and ultimately believe that these activities will lead to an improved way of life. Such tacit assumptions privilege a linear trajectory of scientific reason over other more nuanced forms of knowledge production and education. It is therefore my ambition to create a space to promote such discussion using art as a modality for strategic questioning.

There is an inherent dilemma within my practice as it relies upon some of the technologies that it seeks to be critical of. In this way it is implicated in what Tony Fry (2009) refers to as sustaining the unsustainable. This thesis acknowledges this tension and in doing so explores the multiple perspectives of technological development that are produced through my practice. Whilst I assert that an optimism for technological development needs to be balanced, analysts like Jamison et al. (2011) suggest that there still remains "no real public space for serious discussion of the cultural implications of science and technology in most universities or, for that matter, in the media or anywhere else in the public sphere" (p. 9). In my role as an engineering consultant, I likewise found there was little opportunity for critique and reflection within the industry that would allow for the consideration of other alternative perspectives or internal reform.[9]

By actively engaging with creative practice, this project therefore seeks to open and establish such new spaces for creative, critical and interdisciplinary responses that reflect upon our necessary coexistence with non-humans. Like Hard and Jamison

[9] This is of course also partly due to the client/consultant business model. A paying client is not normally inclined to encourage critique or extensive reflection. Although this type of critique and self-reflectivity is encouraged within a tertiary education, something design theorists like Tony Fry (2009) call "redirective practice" involving "the redesign of design", there often remains little opportunity for this thinking to influence a commercial design practice (p. 55).

(2005), I understand my practice to inhabit a middle ground between the "polarised positions of the technological optimists and their cultural critics" (p. 4). I am also interested in how this practice can provide a platform for a cultural reassessment of science, technology and engineering. It is therefore my ambition to create spaces for reflecting upon, reconsidering and reworking the ways that dominant instrumental paradigms inform perceptions of our relations with non-humans, and to build a creative modality that engages with principles and realities of fundamental ecological sustainability.

THE PROBLEM OF SUSTAINABILITY

The discourse of sustainability is often framed as a series of design challenges to create our objects and systems more efficiently, with longer life cycles and with 'better' and renewable materials.[10] As Fry (2009) articulates, this represents a predominantly instrumental view of sustainability based upon discrete technological solutions that predominantly omit consideration of the complex interplays between social and cultural relations, that in turn bring objects, infrastructures and technologies into being and which ultimately dictate their use. This research project therefore seeks concurrence with Fry's much stronger notion of "sustain-ability" – a major socio-cultural project that involves technological responsiveness, but at its core requires a shift in perception and values[11]. This is a crucial distinction. As Fry (2009) suggests, "the common goal of creating sustain-ability will only stand a chance of realisation if pursued in socio-cultural plural ways" (p. 91). My practice corresponds to this assertion, exploring the use of strategically open-ended systems and technologies from both art and science as a means of invigorating social and cultural engagement with these issues.

[10] The argument that sustainability will be addressed by a coming "technological turn" White (2002) is an approach that gained particular attention in the late 1990s through literature such as Natural Capitalism (Hawken, Paul et al., 1999) and Factor Four (Weizsacker, 1998). These publications not only asserted that our current unsustainable practices (e.g. drastic increases in efficiency and a reduction in waste streams) would be addressed through better design and technological innovation, but also that free market forces would drive the required changes.

[11] Fry understands sustain-ability as the necessary process of changing our collective actions in order to extend the future of our species. He defines the future in an anthropogenic sense, as the time between now and our inevitable finitude. Therefore, Fry refers to unsustainable practices as actions that defuture, that reduce "the finite time of our collective and total existence" (Fry, 2009, p. 6).

Tony Fry, Abby Mellick-Lopes and Timothy Morton are three scholars who clearly articulate a case for interdisciplinary action that goes beyond narrowly conceived technological solutions. In her doctoral research *Ecology of the Image*, design scholar Abby Mellick-Lopes (2009) extends upon Fry's thinking, approaching unsustainability not as a material condition, but as a yet under-developed understanding of how we are connected.

> Unsustainability is characterised … not in the negative, as the binary opposite to sustainability, but as the means of achieving sustainability — it is the observable problem that can be grasped on the way to better understanding what we need to sustain ourselves and that upon which we depend. The disjuncture between ecological impacts that show up in our environments and the unrevised perpetuation of the conditions that cause them indicates that our ability to make connections between actions and material conditions is wanting (p. 9).

By declaring unsustainability as an inability to adequately perceive and acknowledge our intimate ecological relationships, Lopes re-frames our problems as borne of misguided perceptions that have subsequently been cast materially upon the world.

Lopes draws upon Fry's notion of the "televisual" (Fry, 1993) – which posits how cultural imagery prefigures the processes of design (p. 11). "The televisual image throws forward into the world not simply cultural models, but in Marshall McLuhan's evocative words[12], "tactile promptings" for configuring mind, body and environment" (Mellick-Lopes, 2009, p. 12). Philosopher Timothy Morton likewise shares this thinking through his concern for the often-unrecognised status of non-human objects arguing that our struggle to realise such interconnectedness relates to fearing the uncertainty it yields. He observes that the ambiguity of art is valuable for provoking thinking that goes beyond norms and categories (Morton, 2010, p. 60). This understanding of art positions it as a practice well suited to making either the familiar unfamiliar, the invisible visible or the strange stranger – all transitions that these authors argue is critical for producing new thinking around sustain-ability. Clearly there is a case for interdisciplinary and experimental critical practices that question the status quo and throw up other possible ways of realising our ecology.

[12] I consider Marshall McLuhan's (1964) discussion of new media in more detail in chapter 3.

If one of the underlying problems of Fry's "sustain-ability" is the failure to perceive relations and connections, then art can arguably provide different perspectives for ecological structures and ways of thinking. When tackling practices such as science and engineering that are so tightly bound to agendas of objectivity, efficiency and functionality, art provides opportunities for reflection, critique and experimentation. In this way, artistic practice can be used to test the rules and assumptions underlying these disciplines. In this sense art has the potential to reorder our perception of the non-human world, providing glimpses of other models for coexistence. Although often brief and imperfect, such ruptures to our everyday realities may thereby prompt our reconsideration of our perceived ecological status.

MIXED METHODOLOGIES

This research project adopts the overarching methodology of *practice-led research. Practice-led research* can be defined as research program informed predominantly by creative practice, whereby major findings reside in the practice itself. My five creative projects are therefore primary components of this study and materialise its outcomes along side this exegesis. Exhibited publicly during 2010/2011, these featured projects are captured in video and photographs, which are to be viewed from the accompanying disc throughout this exegesis. I have included instruction as to when each video should be viewed throughout this text.

As sub-themes within this practice-led approach I also strongly draw upon *reflection-in-action* and *interdisciplinarity*. *Reflection-in-action* is a methodological approach characterised by Donald Schon (1986, p. 130). It refers to a system structured by cycles of practice and reflection, where both the successes and problems encountered through each artwork have been reflected upon, placed into dialogue with relevant theory and then fed into the direction of the apposite project. Schon (1986) describes this as spiralling through "stages of appreciation, action and reappreciation" (p. 131). This methodology is also inherently interdisciplinary because it extends beyond the sphere of traditional art and aesthetics in order to engage with issues, methods and approaches from other disciplines like science, engineering and design.

Interdisciplinarity is central to my practice as it involves translating ideas, processes and strategies across disciplinary boundaries, yielding important

opportunities for developing a practice that blends artistic strategies with methods of science and engineering. It also provides a means for critical and creative commentary of issues that also do not sit in any one discipline. Authors such as Jamison et al. (2011), Gray et al. (1995) and Latour (1991) have discussed interdisciplinarity as a valuable strategy for research in a contemporary post-positivist paradigm because, in a complex world, it allows for an investigation of complexity. "Many of the ideas in complexity research – messiness, randomness, non-linearity, adaptivity, feedback, and so on seem familiar to artistic ears... Some scientists (Kaufmann, Farmer, etc.) suggest that many of the ideas in complexity research might extend beyond science and be applicable to cultural dynamics" (Gray et al., 1995, p. 14). The complexity of contemporary issues of ecology and sustainability, demand an interdisciplinary engagement in order to fully consider the relationships within which we are bound as well as the construction of their reality.

The artworks are presented here in the chronological order of which they were produced. Although the content and medium of each work varies, conceptual threads and concerns can be traced from one project cycle to the next. The final project, *Coin-Operated Wetland* (2011), results from the final creative cycle and therefore captures the multiple concerns and lines of enquiry that matured through the making of the preceding four works.

This thesis is therefore a consummation of many stages of critical writing and analysis of work undertaken between project cycles and after their completion. It supports my cycles of practice by situating them within historical and theoretical contexts. Each project carries a conversation with the disciplines of ecology, cybernetics and engineering and related critical theory. The dialogue that unfolds investigates our socio-ecological relations and the unique opportunities for art to think through reconfigurations of our perceptions and opinions.

CHAPTER STRUCTURE

Chapter 1 provides a contextual framework for this research project by sketching a brief history of ecology and examining the field's historical intersection with cybernetics. Through two examples, the *Grasslands Biome* and *Biosphere 2*, it unpicks some of the foundational metaphors of ecology such as the reduction of natural systems to cybernetic systems or machinic structures in order to sketch out

the assumptions carried with them. It also outlines some key theoretical ideas from Bruno Latour, who informs the interdisciplinary practices I discuss throughout this thesis. Finally, it introduces the practice of Australian-born artist Natalie Jeremijenko, whose creative works of the last two decades have examined information and the use and misuse of new technologies for social and environmental change. Her practice and methodology has been of significant influence to my work and to the development of this project.

After laying out these initial theoretical and artistic paradigms in Chapter 1, the following three chapters describe and analyse my five artworks. I place these works in dialogue with relevant theoretical questions and paradigms, and articulate the methodologies and insights specific to each work.

The first of these, Chapter 2, considers the human/non-human relationship through *The Bat Human Partnership* (2010) and *The Pollination Service* (2010), two works that respond to the attempted relocation of an urban Sydney flying fox colony.

Chapter 3 considers environmental knowledge production, particularly through the use of distributed computation technologies. It introduces *Oceans of Air* (2011) and *Kilowatt Hours* (2011). Both projects are acts of investigation and information gathering.

Chapter 4 presents *Coin-Operated Wetland*, my most ambitious individually realised project. This work co-opts practices of water engineering in order to illuminate their political and social dimensions.

Finally in the conclusion, I return to my initial research focus in light of the trajectories and intersections of this practice and theory.

Chapter 1: Approaching Ecology - Machinic Metaphors and Black Boxes

This chapter provides historical and theoretical contexts for the artworks I will discuss throughout this exegesis. Firstly, I give a brief account of the intersections between ecology and cybernetics during the twentieth century to illuminate the fundamental assumptions and machinic metaphors that have shaped ecology as a practical and theoretical discipline. By interrogating this history I seek to break open the 'black box' of ecology and foreground the particular approaches and thinking privileged in my own work. Secondly, I consider three key theoretical concepts developed by Bruno Latour, whose philosophy and critique of modernity have been particularly influential: his use of actor-network theory, his concept of the 'hybrid' and his re-purposing of Norbert Weiner's "black box". I will then introduce the interdisciplinary work of *ArtLab* collaborator Natalie Jeremijenko, who has significantly shaped and inspired the methods and ambitions of my practice.

1.1 ECOLOGY AND CYBERNETIC METAPHORS

In this thesis, I approach metaphor from an interactionalist perspective whereby complex concepts like ecology and technology can only be partially understood by their inherent properties. Rather, these concepts are more fully grasped by considering their conceptual interaction with each other; what Lakoff and Johnson (1980) call, their interactionalist properties. Whilst contemporary understandings of ecology have largely been structured through our experience of technological or machinic systems, I also understand ecology to be also shaped by both structural and ontological metaphor. Structural metaphors provide a way of describing the systematic relationships between categories and subcategories eg. an 'ecosystem' or the food 'chain'. The ontological function of metaphor is also central to understandings of ecology and a subsequent ecological worldview. Morton (2010) amongst others argues for a shift to ecological 'thinking'.

Ecology has been influenced by technological and machinic metaphors since early industrialisation. Although self-regulating mechanisms have existed since

antiquity (for example, in the form of water level regulators), the steam engine governor developed in the eighteenth century can be understood as a significant step in bringing the self-regulating machine into wide use (Mayr, 1986). The self-regulating system is the basis for what is also known as the homeostatic machine, a machine that uses feedback mechanisms to operate at a stable equilibrium despite varying external conditions. In his BBC documentary *All Watched Over by Machines of Loving Grace*, Adam Curtis (2011a) analyses the history of how the self-regulating system, as understood through technical systems, was then applied to describe the complex workings of the natural world. The idea that biophysical systems operate as homeostatic machines has been extraordinarily influential in shaping ecology throughout the twentieth century. Curtis emphasises that this metaphor of the self-regulating system contains an implicit assumption that ecosystems tend to a steady state of equilibrium.

Botanist Michael Tansley (1935) was among the first to use the term 'ecosystem' to describe the 'systematic' functioning of non-human environments like forests, grasslands or wetlands. He defined ecosystems as "the whole system (in the physical sense), including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment of the biome…[these] are the basic units of nature" (p. 299). Machinic metaphors using words such as 'system', 'unit' and 'component' are still so prevalent in ecology that it is easy to forget their technological origins. Commentators such as Curtis (2011a), Sarkar & Plutynski (2011), have observed that Tansley assumed that ecosystems universally tend towards a state of dynamic equilibrium and that natural selection favours stability; for example his assertion that "systems that can attain the most stable equilibrium, can survive the longest" (Tansley, 1935, p. 299). This idea of ecological equilibrium remains a stubborn and influential assumption today and the notion that the 'natural world' exists in a balanced harmonious state that then becomes disrupted by humans, reiterates the misconception that humans and environment are separate entities – a false suggestion that fosters the contemporary idea that we can restore ecologies to a 'natural' state.

Ecology has also been profoundly influenced by cybernetics and metaphors of computation. In the 1940s, cybernetics emerged as an interdisciplinary field of research focusing on the study of self-corrective systems that regulate their own

behaviours via a process of feedback. The field came to public attention through the work of interdisciplinary group of thinkers that informally emerged out of the Macy Conferences held during 1946-1953 (Easterling, 2001).[13] This group was concerned with research into "circuits, language, and behaviour and naturally often returned to questions about the mind's structure and to the tantalizing possibility of some similarity between neurophysiology and electronic circuitry" (ibid, p. 33). Of significance was the way electric circuitry was seen to offer a potentially universal model that could explain complex relationships in other disciplines like sociology, neuroscience and ecology.

Figure 1: Prominent biologist of the 1960s, Howard Odum's first presentation of an ecosystem using the symbolism and aesthetic of electric circuit diagrams. (Image by Howard Odum, 1960 cited in Madison, 1997, p. 218)

The field of cybernetics was formally named by Norbert Weiner during World War II, when he developed an electric military system to predict the path of enemy fighter planes from the ground (Galison, 1994). Galison (2003) argues that Wiener's pioneering *AA Predictor* is significant as conceptually, it treated the enemy pilot and plane as treated as one interconnected system – as a 'black box'. It acknowledged no

[13] Held in the post-war period, the Macy Conferences were attended by scientists such as Warren McCullough, Norbert Weiner, John von Neumann as well as anthropologists and sociologists like Margaret Mead, and Gregory Bateson among others (Easterling, 2001).

boundary between human operator and machine, just a target whose position was predicable three seconds into the future (p. 263)[14].

A black box is an entity that is only analysed externally in terms of inputs and outputs – it gives no access to its internal workings. In the case of the *AA Predictor*, Wiener had no access to information of the interior of the enemy human/plane system – from his perspective it was a black box. Yet through his *AA Predictor*, the resultant movement of this complex system could be anticipated and therefore, its interior details were made less relevant. Since then, the black box has developed as a metaphor to describe objects or systems whose interiors are or can be taken as givens particularly through the theoretical work of Bruno Latour (Harman, 2009, p. 33). Latour's black boxes manage complexity (see section 2.2), and in this way they have become conceptual tools that are deliberately or inadvertently applied throughout areas of study such as ecology and technology. In this sense my own work seeks to lift the lid off some of these 'black boxes' to reveal and reconsider their internal assumptions.

Towards the late 1960s, ecologists were having difficulty verifying Tansley's assumption that ecosystems self-regulate towards a state of homeostasis (Curtis, 2011b). A prominent example of this is the ambitious, large-scale ecosystem modelling project, the *Grasslands Biome*, which begun in 1968 at Colorado State University[15] (Kwa, 1993, p. 1). The *Grasslands Biome* was an attempt to comprehensively describe a grasslands ecosystem by computationally modelling it to test and reveal ecological principles. Employing hundreds of fulltime researchers, the project involved extraordinary methods of data collection[16] as researchers tried to account for all forms of energy entering and leaving the system. They aimed to quantify everything that was eaten and excreted by all organisms in the biome and input this data into a mathematical model. However the *Grasslands Biome* model,

[14] For a detailed discussion of Weiner's contribution to approaching uncertainty and cybernetic systems see *How We Became Posthuman* (1999) by N. Katherine Hayles.
[15] It was part of the larger International Biological Program (Kwa, 1993).
[16] Researchers would follow animals around the grasslands all day whispering into tape recorders to orally document everything they observed the creature eat or excrete or they would 'collect' animals so their stomach content could be analysed by inserting probes into their digestion systems (Coupland 2009). Soil microbiology was also analysed. Yet soil invertebrates and highly mobile species such as insects and birds remained frustratingly uncooperative in yielding information to researchers (Coupland, 2009, p. 35).

like similar large-scale ecological modelling programs of the time, failed to reveal any new ecological principles. As such, it was deemed a failure, as being "too simplified biologically" despite it implementing an unprecedented number of variables (ibid, p. 154). As it was modelled upon Tansley's assumption of default equilibrium, the only driving variables were external factors such as weather. As such, the *Biome Model* was simply "a sophisticated version of a cybernetic system…and cast…the ecologist in the role of systems engineer" (ibid, p. 146). The project thereby disproved its foundational hypothesis – that complex ecological realities can be reconciled with mathematical models and described as abstracted machinic structures of inputs and outputs. "The grandiose ideal of achieving total control over ecosystems, which around 1966 appealed so much to systems ecologists as well as Congressmen, was dismissed as a hyperbole" (ibid, p. 155). This is symptomatic of a wider problem with the limits of ecological modelling and predictions and evidences the deeply embedded assumptions that are bound up in our concept of the 'natural world'.

Biosphere 2 is another watershed moment in ecological experimentation during the late twentieth century that repeats the assumptions of the *Grasslands Biome* by surmising that the environment is calculable, predictable, reproducible and therefore, at the same time, perfectible. *Biosphere 2* attempted to construct a huge, sealed ecological system in the Arizona Desert, USA, which could sustain eight human beings completely cut off from the outside (Cohen & Tilman, 1996).

Figure 2: *Wave Room*, (2008), Mary Mattingly. This is a photograph from within *Biosphere 2* as a part of a photographic series exploring nostalgia at Utopian sites.

Despite its technological sophistication, *Biosphere 2* failed due to rocketing carbon dioxide levels, species extinction, lack of available food and huge populations of cockroaches and ants that eventually chewed their way through the membrane of the dome and escaped into the desert (Cohen & Tilman, 1996). The unpredictable ecological evolution of the project was also observed in the social ecology between the human bioneers – unrest developed that eventually led to the formation of two rival groups who barely communicated by the end of the project.

According to Jean Baudrillard (1994), *Biosphere 2* exemplifies attempts to simulate perfected versions of nature by removing culturally undesirable entities like bacteria, bugs, scorpions and variable weather conditions. Ironically, the omission of these entities contributed to the unpredictable trajectory of the system and demonstrates the project team's failure to understand the interconnectedness of

earth's ecologies – ecologies that are completely distinct from idealised visions. After two years when the bioneers abandoned the Biosphere (Bartram & Shobrook, 2000), the project was widely considered a failure due to it becoming uninhabitable for the human 'population' (Turner, 2011, p. 20). However, from the perspective of the cockroach population, *Biosphere 2* was a glorious success.

Figure 3: *Biosphere*, (2008b) Mary Mattingly. This is a photograph from within *Biosphere 2* as a part of a photographic series exploring nostalgia at Utopian sites.

As Baudrillard (1994) asserts, *Biosphere 2* was an idealised ecological simulation but one that fails to acknowledge its own embodied cultural preferences and references. The omission of certain undesirable organisms from the Biosphere exposes the biases of scientific drives for control. It helps us understand the project as a complex and disruptive blend of nature and culture. Cultural perspectives informed decisions that were made under the banner of science and therefore reveal

the two as being intimately connected. Historical failures such as these are important lessons for the development of my own artistic approach as I too seek to focus on the contradictions and paradoxes of ecological discourse and open them up to achieve a better reflexive understanding of our ecology.

For Baudrillard (ibid, p. 87), just as Disneyland functions to create an illusion of the distinction between reality and fantasy, *Biosphere 2* brings the paradoxes of contemporary ecological relations into sharp focus. Outside the geodesic dome, we are "carrying on – in real time and out in the open – the same experiment in *Biosphere 2*, which is therefore only falsely experimental" (ibid, p. 87). Almost two decades on, in view of the contemporary climate crisis and rapid human induced environmental change, Baudrillard's observation still rings true.[17]

1.2 BREAKING BARRIERS AND OPENING BLACK BOXES

Bruno Latour is also an important reference point for this research because he not only unpacks certain assumptions and contradictions of science, understanding it as inseparable from politics and culture, but he also then seeks to describe the world through theoretical structures that privilege complexity over reduction (Harman, 2009). In this section I briefly discuss three Latourian structures relevant to this research: actor-network theory, the 'hybrid' and his appropriation of the 'black box'.

Latour's actor-network theory is a philosophical structure that resonates strongly within the field of ecology. It attempts to scaffold the world by understanding it as made up of innumerable actors – human, non-human, natural and synthetic – whose individual contexts constantly intersect and inform each other. You the reader, your computer, the coal being burnt somewhere to power it, the chair that's holding you up, the bacteria in your gut, are actors reacting and relating to one another to bring this particular moment of reality into being. For Latour, the world is a dynamic network full of these jostling yet interconnected forces. As such the human perception of reality is not elevated to a privileged position above that of any

[17] The old Biosphere site, once located in a remote part of the Arizonian desert is now being encroached upon by suburban sprawl, as can be seen in a 2012 Google earth image. The site was briefly threatened with development in 2007 (Anon, 2007), but is now being used for climate change research by the University of Arizona.

other actor as they are in Kantian philosophy[18] and the Enlightenment project (Harman, 2009). Significantly, Latour does not impose an actor network structure as a strategy in reduction; rather he employs it to embrace the complexity of our networks that reveal the world in innumerable resolutions.

Latour and fellow philosopher of science Michel Serres describe hybrids as instances where it is impossible to distinguish "supposed hard facts from supposed social constructions or projections of value" (Harman, 2009, p. 62). Phenomena like contraceptives, rare flora as well as *Biosphere 2* are all impossible to distil into the two distinct spheres of 'culture' and 'nature' (Latour, 1991). Through arguing against such Modernist binaries Latour's work questions other dichotomies such as those between science/politics and human/non-human. His stance for hybridity therefore also has implications for assumptions within ecology and has informed this study.

As aforementioned, Latour (1987) adapts Wiener's concept of the 'black box', and deploys it theoretically to describe areas of assumed knowledge or little considered processes of knowledge production. He uses it metaphorically to indicate when a cohesive group of actors gain an unquestioned status and therefore are not consciously considered (Latour, 1987, p. 131). As Harman (2009) observes, black boxes are crucial for managing the 'resolution' of the world; "[they are] something we rely on as a given in order to take further steps, never worrying about how [they] came into being" (p. 38). In Latour's thinking, black boxes become apparent when they fail or cease to function as expected. For example, we think of a glass of thirst quenching water as being a black box, until we hear that it might contain bacteria.[19]

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[18] Conversely this also requires the suspension of philosophical investigations into the traditional metaphysical problems associated with human subjectivity. Kantian (and post-Kantian) philosophy typically treat subjectivity alongside rationality and self-consciousness as unique to the human condition. Subjectivity in particular is fraught with the problem of the gap between phenomena and noumena, the abyss into which contradictions flow. I follow Latour and Morton in holding the problem of subjectivity in abeyance. Instead of seeking to extend these traditional problems of consciousness to the non-human world, this research treats the internal characteristics of consciousness as a black box, electing to understand it as something to be attributed to both human and non-human actors as circumstances demand. Morton (2010), like Latour, argues that this kind of "flat ontology" is productive, rather than an impoverishment, and provides a Cornucopian Revolution, a world without a centre or edge (p. 38).

[19] In the last decade, many media arts have embraced the opening of technological black boxes through the vehicles of open source hardware and software as well as the adoption of activist tactics like hacking, bending and re-purposing – for example artists like Evan Roth and James Powderly of Graffiti Research Lab, Aram Barthol and Usman Haque. This focus has emerged out of the growing status quo of technologies such as the hyper-designed and technologically opaque products of Apple, that no longer allow us to even readily change a battery.

In this way, the failure of *The Grasslands Biome* and *Biosphere 2* inadvertently allow us to glimpse the limitations of technological metaphors for describing complex ecologies. This research project proposes that creative practices can also fulfill this role by prompting us to reconsider our cultural conditioning and preconceptions of the world by breaking our expectations of the everyday. Many artists have achieved this with great effect using a variety of strategies to surprise and briefly confuse or deceive the viewer in order to prompt them to question their assumptions. These include practitioners such as Agnes Meyer-Brandt known for her series of instruments and devices for investigating the world[20], Auger Loizeau and his pseudo-technological products[21], Carston Höller through his large scale installations that 'model' scientific experiments[22] and Natalie Jeremijenko through the *Environmental Health Clinic* (*EHC*)[23].

In this project I have specifically focused on the practice of Natalie Jeremijenko as her methods of emulating a practice of science and engineering for artistic ends resonate strongly with my own work. The *ArtLab* team had first hand experience working with Jeremijenko on the *Bat-Human Partnership*, outlined in Chapter 2. I give a brief overview of her work here and extend my analysis in more detail in Chapters 2 and 3.

1.2.1 Natalie Jeremijenko

New York-based Australian artist, Natalie Jeremijenko came to notoriety during the 1990s for her experimental practice that investigated science, technology and information.[24] Her work of the last decade has focused on methods for developing innovative and experimental strategies for improving 'environmental health' and fermenting social change; for example *Amphibious Architecture* (2009)

[20] *SGM-Iceberg-Probe* (Meyer-Brandt, 2008) and *Core-Sample Scanner* (Meyer-Brandt, 2003) present the viewer with scientific looking instruments for the investigation of the subterranean conditions of the earth. By adopting the aesthetic and rituals of scientific investigation, but by presenting the viewer with something quite different, Meyer-Brandt breaks open the black box of technologically mediated investigation.
[21] See Auger Loizeau's work *Audio Tooth* (2001), a wireless tooth communication device that is presented as a forthcoming telecommunications product.
[22] See Carston Höller's series titled *Soma* (Höller 2010) where he placed 12 reindeer in two pens and fed half with the fly agaric mushrooms which turns their urine into a hallucinogen and half with normal mushrooms. The viewers then had the option to drink a urine sample not knowing which group of reindeer it had come from.
[23] See the section 2.2.1.
[24] Many of Jeremijenko's early work can be seen on documented the BIT Website (Jeremijenko, 2006a).

and the *Cross[X]Species Adventure Club* (2011). Often involving DIY and open source technologies such as hacked robotics in *Feral Robotic Dog* (Jeremijenko, 2003), her work aims to foster individual agency for action in response to issues of environmental health.

Jeremijenko's earlier works investigate information as a medium. Working as the *Bureau of Inverse Technology* (BIT) her practice was articulated through the innovative use or misuse of technology (Jeremijenko, 2006a) for the novel collection and communication of information. For example, the use of a distributed networks of cameras triggered by the sound of gunshot (Jeremijenko, 2002), or use of motion triggered cameras to record suicides as people jumped from the Golden Gate Bridge in *Despondency Index* (Jeremijenko, 1997).[25] She also experimented with methods of presenting, communicating and demonstrating the materiality of information. In the 1995 work *Dangling String*, Jeremijenko hung a wire from the ceiling of the *Xerox PARC* office that would move according to the amount of Internet network traffic running through the building. It is widely considered to be an early example of ubiquitous technologies where computation is distributed into objects (Weiser & Brown, 1996). These works thereby raise key questions around the makeup of information is and how it is ultimately captured and interpreted. They explore and problematise scientific methods by expanding the possibilities for how media technologies can be used. In these ways Jeremijenko visualises information in alternative ways to connect seemingly distinct social, cultural, economic and natural phenomena, a tactic that provides new insights to what was previously boxed or hidden.

As with my own work, the locus of Jeremijenko's artistic methodology is an exploration of what sociologist Allen Irwin coined 'citizen science' (Irwin, 1995). This is a participatory research approach that can be traced back to the 1970s, to the context of the environmental and anti nuclear-energy movements, and to the rash of publications promoting small-scale appropriate technologies such as distributed solar energy and water systems.[26] During this decade these intersecting forces saw activists, academics and the public collaboratively examine problems such as

[25] The number of people recorded to have jumped was then compared to the fluctuation of the US stock exchange in an attempt to interpret a relationship between suicide and economic activity.
[26] These include *Small is Beautiful* by E.F. Schumacher (1973), *Tools for Conviviality* by Ivan Illich (1973) and *Alternative Technology and the Politics of Technical Change*, by David Dickson (1974).

distributed energy provision through initiatives such as the *Science Shops* set up in Dutch universities (Jamison et al., 2011, p. 135). Jeremijenko's current interdisciplinary practice echoes these initiatives as they continue to connect activist and research agendas under the banner of the *Environmental Health Clinic* (*EHC*).

In the *EHC*, Jeremijenko (2012) uses the structure of a university medical clinic as a model for engaging citizens as collaborators in hybrid art and science practices. Loosely emulating a medical health clinic, citizen collaborations typically start with a consultation often carried out as an often spectacular, mediagenic performance in public space. In this consultation, Jeremijenko dresses as a doctor and interviews her collaborator regarding the nature of their environmental concern. Then based on this information, Jeremijenko and her team develop a 'prescription' for the concern. These are performative, playful and provocative responses to the local environmental issue designed with the activist aim of publicly garnering attention. An example of this is the work *Clear Skies* (2004) where, in response to an air quality health complaint, the *EHC* developed face masks that visualised air quality when worn around the streets of New York City. As such, Jeremijenko's work employs humour and performance to expand the landscape of human health beyond that of the individual body to include the condition of the local environment. Congruent with the model of health care, the onus is therefore on the patients to treat their own ailments by taking action in response to the environmental issue at hand (Jeremijenko, 2012). In this way, *EHC* projects are devised to cast the collaborator into an active role encouraging them to experiment with methods of revealing or acting upon their environmental concerns.

Figure 4: *Environmental Health Clinic* Website, screenshot taken February 1, 2012 (Jeremijenko, 2012)

Through this structure, Jeremijenko's work is radically anthropocentric in that she seeks an active response to environmental issues by framing these issues as human health concerns rather than playing on normative eco-critical motivations. By asserting that environmental problems are simultaneously health problems, she recognises the environment as critical to human health and thereby shifts the traditional notion of health from one that is internal to something that is external, shared and central to our ongoing survival. Her work applies a radically different lens to issues of urban sustainability that typically defer to a sense of self-sacrifice and are imbued with narratives of crisis. Her work thereby compels the viewer in different ways.

In contrast to examples like the *Grasslands Biome* and *Biosphere 2* that were founded on an assumed ability to know, to control or to perfect ecology, Jeremijenko's practice is founded on asking questions through quasi experiments and tests. For example, *Amphibious Architecture* (2009) publicly asks, how many fish are in New York's Hudson River? How does this relate to water quality? And, how can this data be synthesised? Such questions are typically unpacked by novel information visualisation strategies that prompt the viewer to actively interpret information. Therefore in Jeremijenko's work the state of the environment is under question and worthy of interrogation.

Jeremijenko's projects are skilfully mediagenic and often spectacular, something that science and engineering activities generally neglect. Jeremijenko uses both the branding of the EHC and her performances in public space as aesthetic and visual strategies to move her work to audiences beyond those of the 'gallery' and out into other disciplines. The online visibility of her work demonstrates this as a possible tactic available to raise the profile and increase the reach of my own interdisciplinary practices. Her projects provide potent examples of interdisciplinarity operating at the intersection of art and science. They redeploy the techniques and methods of science (for example information collection and synthesis) in combination with artistic strategies such as visualisation, performance, and relational aesthetics. This methodology allows Jeremijenko to destabilise current assumptions and approaches within environmental relations and politics. Her experimental strategies have therefore strongly influenced my own work and thus I introduce further relevant examples of her practice in chapters 2 and 3.

Within this chapter I have assembled a collection of ecological histories, theoretical ideas and interdisciplinary practices that strive for a richer understanding of the position of the human in the ecological scheme of things. By tracing these machinic metaphors and cybernetic conceptual forms through a variety of disciplinary arenas, I have sought to make connections and problematise the notion of a static, objective view of the non-human. All of these ideas emerge in my own creative practice. I continue to call on the evolving body of ecological theory as well as examples of Natalie Jeremijenko's work throughout the following chapters. I examine how my own creative practice engages with questions about ecological metaphors and assumptions around the human ability to control.

Please refer to the following videos and accompanying images that are included on the enclosed disc before reading Chapter 2:

- *The Human Bat Partnership*, 2010. Duration: 11:34 minutes.
- *The Pollination Service*, 2011. Duration: 1:12 minutes.

Chapter 2: The Bat-Human Partnership and The Pollination Service

> [Mistletoe] draws in nourishment from certain trees, which has seeds that must be transported by certain birds, and which has flowers with separate sexes absolutely requiring the agency of certain insects to bring pollen from one flower to the other…It is equally preposterous to account for the structure of this parasite, with its relations to several distinct organic beings, by the effects of external conditions, or habit, or the volition of the plant itself.
>
> (Darwin, 1859, p. 13)

This chapter analyses two creative projects, *The Bat Human Partnership* and *The Pollination Service*. Through speculative design practices both works seek to reconfigure the relationship between humans and other species that also inhabit the urban environment. In the previous chapter, we saw how the choices of species in *Biosphere 2* were informed by implicit cultural biases, a factor that also shapes the biodiversity of our urban spaces. Many recent studies have connected urbanisation with increasing levels of species extinction (Czech, Krausman & Devers, 2000). It is evident, therefore, that to maintain the health of our remaining urban ecologies, it is necessary to start catering for the needs of humans and non-humans alike in our urban spaces. Creative practices and critical thought have important roles to play in imagining ways to achieve this.

In this chapter I examine how interdisciplinary art practices offer opportunities to radically rethink our urban and institutional environments. The two projects, *The Bat-Human Partnership* and *The Pollination Service,*[27] both suggest conceptual and practical strategies for achieving a shift towards species-centric design, or what Jeremijenko calls the 'species city' (Jeremijenko, 2006c). These projects respond to the proposed relocation of an urban flying fox colony, which in 2010 was roosting

[27] These artworks exist in dialogue with the historical and theoretical territory outlined in the previous chapter, drawing the concepts out into real world situations and into an emergent research process.

within the Sydney Royal Botanic Gardens (*RBGT*). *The Bat-Human Partnership* considers the issue at a city level by interrogating how the ideology of our institutional structures becomes materialised through the urban environment. *The Pollination Service* investigates the capacities of flying foxes as Myrtaceae pollinators (Fujita, 1991, p. 6) on an individual scale through the process of translating their activities across species boundaries. These are both speculative works that seek to open spaces for considering alternative modes of co-existence.

2.1 A CALL FOR COEXISTENCE

The Bat-Human Partnership and *The Pollination Service* are informed by a range of theoretical work that stresses the need for alternative models of co-existence. Timothy Morton's (2010, 2007) philosophical positions extend the theoretical trajectories of Bruno Latour by arguing for "the ecological thought", an approach that privileges the complexity and intimacy of our relationships with other non-humans, free from the historic construction of 'nature' (Morton, 2010, p. 29). He critiques nature as an idealised concept that reinforces the distance and separateness of the human from the surrounding environment.

> The ecological thought permits no distance. Thinking interdependence involves dissolving the barrier between "over here" and "over there," and more fundamentally, the metaphysical illusion of rigid, narrow boundaries between inside and outside. (Morton, 2010, p. 39)

Morton (2010) confronts the problem of human and non-human coexistence by refusing traditional boundaries and categorisations. For example, he rejects the term 'animal' due to its implication of a hierarchy that places humans at a higher order than other species. He calls for an exploration of the "paradoxes and fissures" within "humanness" or "animalness" so that rather than trying to assimilate the animal into the human or vice versa, the strangeness of these concepts is celebrated (ibid, p. 40). Morton argues that reconsidering traditional distinctions this way helps to disrupt other assumptions, such as the supposed equivalence between information and knowledge (ibid, p. 41). He suggests that as we become privy to more information about the non-humans around us, the more intimate we become with them, which paradoxically makes them stranger and uncanny. In some ways, this equates with the idea that "We [lack] the creative faculty to imagine that which we know" (Shelley, 2002, p. 530). Morton (2011) extends this by arguing in "imagining what we know"

we must do away with the assumption that objects, or non-humans, are "totally accessible structure[s]" He highlights that the instrumental production of information is only one side of the coin and that the ability to imagine, apply and culturally inseminate the significance of this information is often invisible or unacknowledged.

As Morton (2010) suggests, art consequently becomes an important space to think through how we might better achieve this 'insemination' (p. 60). He argues that art has the potential to examine these issues by researching, testing and exploring the human/non-human relationship, as well as the deeper assumptions that operate within it.

2.2 SPECULATIVE AESTHETICS

In *Herzian Tales*, designer and theorist Anthony Dunne[28] (1999) investigates the aesthetic possibilities of electronic objects through a speculative exploration of the interrelationship between electronic objects and culture. He presents a compelling case for new design research that extends beyond the "technologically possible" and the "semiologically consumable" that maps and critiques the social, psychological and cultural mechanisms built into the design of contemporary electronic objects (ibid, p. 12).

> The challenge is to blur the boundaries between the real and the fictional, so that the visionary becomes more real and the real is seen as just one limited possibility, a product of ideology maintained through…uncritical design. (Dunne , 1999, p. 68)

I similarly approach my art practice as a mode of critical design in that I aim to broaden the perceived possibilities for both the management of the ecologies of urban spaces and the design of urban infrastructures. I achieve this by presenting alternative design proposals but in the image the institutions that manage these spaces. In this way, the subversive and unconventional ideas presented in my work appear closer to the realm of possibility. *The Bat-Human Partnership* and *The Pollination Service* both operate with this speculative agenda, by working to disrupt

[28] Anthony Dunne is a proponent of the discourse of critical design and is particularly well known for his work with Fiona Raby. See Dunne and Raby (2001) *Design noir: the secret life of electronic objects*.

and challenge how we perceive interactions with our fellow non-human species. Dunne (1999) calls this creative strategy of co-opting the aesthetics of real institutions and entities, of blurring of reality and fiction, "real fiction" (p. 68).

Jeremijenko adopts this strategy of 'real fiction' by presenting as an artist, pseudo-engineer, doctor and scientist. She deliberately cloaks her practices with the aesthetics of other disciplines like medicine and environmental science, allowing her to co-opt the viewer's expectations. It becomes unclear to the viewer or visitor of the *EHC*, whether it is reality or fiction, art or science, medicine or performance. Her activities, in the clinic therefore appear to be forms of environmental science and engineering that achieve real world environmental remediation through improving urban ecosystem health. When we realise that these activities are actually art practices, we are able to reflect upon other possible ways that environmental remediation could be carried out. This ability to pick and choose different methods and identities in order to manipulate belief systems and the expectations and assumptions that go along with them, is integral to art's critical and creative capacities. Specifically, creating a brief deception in an artwork, where fiction momentarily seems real, is a tactic that effectively initiates a speculative engagement from the viewer and forces them to challenge their own aspirations, anxieties and assumptions. As Dunne (1999) states, such speculative practices are "conceptually difficult to assimilate…They challenge how we think about extensions to our 'selves' in ways that do not simply magnify but, rather, transform our perception and consciousness of our relation to our environment" (p. 68). In short, speculative practices cause us to consciously re-evaluate our assumptions of scientific and environmental possibilities.

2.3 NATALIE JEREMIJENKO'S *OOZ PROJECT*

Natalie Jeremijenko's *OOZ Projects* (2006) set out to explore urban human/non-human relationships, directly critiquing the zoo as an institution that co-opts 'nature'. The *OOZ* projects were initially located outside the gallery and facilitate interactions with other urban species that inhabit our cities. As "a zoo without cages…[where] the animals remain by choice"(Jeremijenko, 2006b), *OOZ* refuses the conventional treatment of zoo animals as passive objects by acknowledging the species within the project as active subjects who are free to come and go as they choose (ibid).

Figure 5: A bird perch as a part of Natalie Jeremijenko's work *For the Birds* which was installed as a part of *OOZ Projects*, Whitney Museum of American Art (Jeremijenko, 2006c).

In Jeremijenko's work, human interactions with *OOZ* animals are exaggerated, absurd and facilitated via technological means. For example, in *Amphibious Architecture* (2009) you can visit 'Jose' (a beaver living in the Hudson River) and have him reply to you with reports on the river's water quality (Brahic, 2009). In *Robotic Geese* (2006b) you can steer a remote controlled robotic goose across a lake to interact with goose populations. *For the Birds* (2006c) allows birds to trigger messages to a human audience via interactive perches. In these ways *OOZ* questions the notion of a wild, distant and fetishised nature that is so often portrayed by urban zoos. There are no elephants standing in front of painted concrete backdrops of a distant African savannah. Instead, the project utilises electronic sensors and mobile technologies to draw attention to the presence of non-humans with whom we share our local environments. The work overtly refutes the dominant 'non-interaction' mode epitomised by slogans such as 'don't touch' and 'don't feed the animals'.

Figure 6: Bird perch detail as a part of Natalie Jeremijenko's work *For the Birds* which was installed as a part of *OOZ Projects*, Whitney Museum of American Art (Jeremijenko, 2006c).

Jeremijenko states that the *OOZ Projects* are based on "an architecture of reciprocity: i.e. any action you can direct at the animal, they can direct at you" (Jeremijenko, 2006b). One criticism of the strategies used in *OOZ* relates to the illusion that the animals are reacting and the work deliberately plays into an anthropomorphic fantasy. The animals are cast as entertaining, humorous and cute yet on the other hand, the viewer is not required to adjust their mode of communication or compromise their humanness at all. This asymmetry is an overt reminder of what Stephen Muecke (2006) identifies as a central problem when attempting to represent other species (or non-humans more generally) and have them participate in new political structures. How do we make them speak? How do we ascertain what they want? How do we adequately represent them? Muecke argues that non-humans are not at all interested in participating in our democratic structures and therefore how to include them is deeply problematic.

Jeremijenko explores one aspect of this problem of politically representing non-humans by playfully establishing *OOZ Projects* as a legally constituted company and then placing the animals on the imagined board of directors. According to US

corporate law, this thereby affords these species equal rights, equivalent to that of a human. This aspect of *OOZ Projects* fuses art with real world legal structures in order to explore ways of including non-humans in the human realm of politics and economics. Through these different methods, the artist exaggerates our anthropomorphic fantasies about animals and by extension, questions the conventional constructions of 'nature'. The strategy of radically anthropomorphising animals works to demonstrate the absurdity and inequality of our cross-species relationship.

2.4 BAT-HUMAN PARTNERSHIP

In extending on the strategies of critical design, The *Bat-Human Partnership* was a collaborative research project involving a multidisciplinary group led by Natalie Jeremijenko as a part of the Sydney *ArtLab* residency.[29] The resultant work, *The Botanic Gardens X-Tension,* was developed in the style of an *EHC* prescription (Jeremijenko, 2012) and responds to the proposal by the Sydney Royal Botanic Gardens (RBG) intention to relocate up to 22,000 grey-headed and black flying Foxes from the gardens (Ree, North, and Hsu, 2009).

Grey-headed flying foxes are a migratory bat species that predominantly inhabit the east coast of Australia and are presently classified federally as 'vulnerable to extinction'.[30] They are generalist eaters, but prefer pollen and the nectar of flowering Australian tree species. Flying foxes are nocturnal animals that roost during the day at colony sites that are located throughout the Eastern seaboard. Urban flying fox colonies exist in the Botanic Gardens in Sydney, Brisbane and Melbourne.[31] As with many of these urban colonies, the Sydney *RBG* flying fox

[29] For information about the context and aims of this project refer to the project website: http://www.remnantartlab.com/lab-2/. Retrieved May 1, 2012.
[30] However, authors such as Tilderman and Nelson (2004) argue that the Grey Headed Flying Fox should be classified as a threatened species under special provisions that exist in Australia for the conservation of threatened migratory birds, which takes into account the difficulties faced in accounting and managing migratory species. The Australian Government, Department of Sustainability, Environment, Water, Population and Communities (Australian Government Department of Sustainability, Environment, Water, 2012) observe that counts of Grey Headed Flying-Foxes conducted in 1989 and 1998-2001 indicated a 30 per cent decline in the national population.
[31] The Melbourne Botanic Gardens relocated their colony during the period 2004 and 2009. For details of this refer to the 'Public Environmental Report' (Ree et al., 2009). Ecologists Parris and Hazell (2005) argue that this camp was relatively easy to relocate as it is a recently established flying fox site that sits outside the historic range of the species. The authors argue that the flying fox presence in Melbourne could well be attributed to changes in migratory patterns due to climate change adaptation.

camp has increased in size due to substantial land clearing (Hall & Richards, 2000) that have significantly reduced the availability of food and habitat in the bush, whereas the diverse range of street trees and park vegetation in cities have made places like central Sydney a desirable alternative (McDonald-Madden, Schreiber, Forsyth, Choquenot & Clancy, 2005).

The *Royal Botanic Gardens Trust (RGBT)* in Sydney oversees the management of these gardens with a charter to conserve their vegetation. The *RBGT* have sought to remove the mammals over many years due to the bat population causing mechanical damage to their heritage trees during daily roosting. They therefore view the flying fox as a pest, arguing that their trees are not only biologically significant to an international botanic conservation program, but that they are also important as Australian cultural heritage given that some trees are deemed part of Sydney's settlement history.

In light of the tree damage (Ree et al., 2009), the *RBGT* proposed to relocate the population using noise disturbance as has been done in the Melbourne Botanic Gardens (Ree, North, and Hsu, 2009, p. 16). Many ecologists and conservationists strongly advised against such actions as the flying fox population is already known to be under considerable stress (Woodhead, Biel, O'Shannessy and Martin, 2009). The ecologists argue that the conservation of the flying fox is of critical ecological importance because they pollinate and distribute seeds for the Australian Myrtaceae vegetation group and in turn, serve as an important food source for the animals (Fujita, 1991). Should the flying fox populations continue to decline, it is posited that this group of Australian vegetation would be less able to reproduce and could ultimately be rendered functionally extinct (Rose, 2011).[32]

Whether we place a cultural significance on the flying fox or not, as Charles Darwin described, we are intimately involved with them through a complex mesh of interdependencies. This knot of viewpoints, desires and priorities resists purification and separation into distinct arenas of politics, environment, nature and culture. Drawing on Harman's (2009) discussion of Latour, the plurality and complexity of this situation cannot and should not be suppressed. Central to this thinking is the

[32] This was the fate of the vegetation of Biosphere 2 when their populations of pollinating insects perished early on during the project (Cohen & Tilman, 1996).

understanding that all relationships and interactions between actants should be related and equal without privileging those that involve humans.

2.4.1 Background: The *ArtLab* Workshops

Our speculative design project revolved around this complex problem and was informed by a three-month consultation process conducted by members of the *ArtLab* team. We worked closely with local stakeholders from government, biological research groups and the Botanic Gardens to develop shared understandings and build trust around this fraught and long running issue. Key stakeholders were then invited to attend a two-day workshop, which in addition to the *ArtLab* team, incorporated a range of other artists, scientists, architects and academics – all focused on examining the problems of accommodating such large urban flying fox populations in the heart of Sydney. The workshops[33] emphasised the ecological connectedness of the flying fox and examined a range of perspectives on the management of urban animals informed by representatives from the *RBGT*, bat research groups and academic communities.[34]

2.4.2 Project Description: *The Botanic Gardens X-Tension*

The Botanic Gardens X-Tension (Artlab, 2010) became a speculative proposal for a re-imagined Sydney Botanic Gardens that was developed by the core team following these discussions. This speculative work envisages a new institution that embraces a radical ecology that moves beyond existing and limiting categories of nature, artificial, culture and science. *The Botanic Gardens X-Tension* is a distributed institution that links various flying fox habitats throughout Sydney with a particular focus on the Sydney Barangaroo development site,[35] one of the largest brownfield

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[33] These were followed by a two-week residency for the artists involved in the project at *Artspace*, Sydney with the outcomes ultimately exhibited as a component of Natalie Jeremijenko's exhibition *'X'*, held at UTS Gallery in October 2010.

[34] John Martin, the Wildlife Management Officer from the *RBG* who is in charge of the planned dispersal focused on the compromised health of the Botanic Gardens trees where the bats were roosting and discussed the organisational bureaucracy of institutions like the *RBG*. David Hancocks, who has been director of Werribee Open Range Zoo and Woodland Park Zoological Gardens, Seattle, discussed the negative public attitudes held towards urban animals in contrast to the elevated status of exotic animals in the context of a zoo. Professor Deborah Bird Rose interpreted the issue through the lens of Australian colonial history drawing out parallels to the repression and mistreatment of Australian indigenous human populations.

[35] For more information on Barangaroo development, see the project website Barangaroo Project Website 2010. *Barangaroo Delivery Authority*. Retrieved December 1, 2010. http://www.barangaroo.com/.

sites to be developed in Sydney since the 2000 Olympics (Abel, 2010). Barangaroo is a contentious and ambitious project that presents a mixture of public parkland and commercial space, as well as high-density housing, within the context of a large harbour front of disused container wharves, less than 2 kilometres from the *RBG*.

Figure 7: Re-imagined visualisation of Barangaroo from the *Bat-Human Partnership*. Image credit: Tega Brain.

In view of the current priorities of the Sydney Botanic Gardens, we proposed that the Barangaroo site could offer Sydney an extension to the current concept and reach of the existing Botanic Gardens, seeing the site's parkland developed into potential real estate for urban animals like the flying fox. In this way, the flying fox's accommodation options in Sydney would be augmented and pressure on the existing site would be reduced. Our question therefore was direct: why not make the criteria for judging the success of major urban developments incorporate healthy populations of other species? This critical design proposal was exhibited as a component of Jeremijenko's *'X'* exhibition at UTS Gallery (2010) via a project website[36], publication materials and video documentation (Artlab, 2010). The exhibition material was branded to emulate the design and promotional material produced by the actual Barangaroo developers. In these ways we consciously adapted Dunne's (1999) strategy of "real fiction" to demonstrate the current plan for Barangaroo as "just one limited possibility, a product of ideology maintained through the uncritical (urban) design" (p. 68). I specifically reworked existing images from the official Barangaroo website to present a more biodiverse vision of the future where humans

[36] See http://www.xtension.cc/. Retrieved June 1, 2012.

and non-humans are acknowledged as intimately interconnected. The uncanny results of this process are shown in Figure 8 – Figure 10.

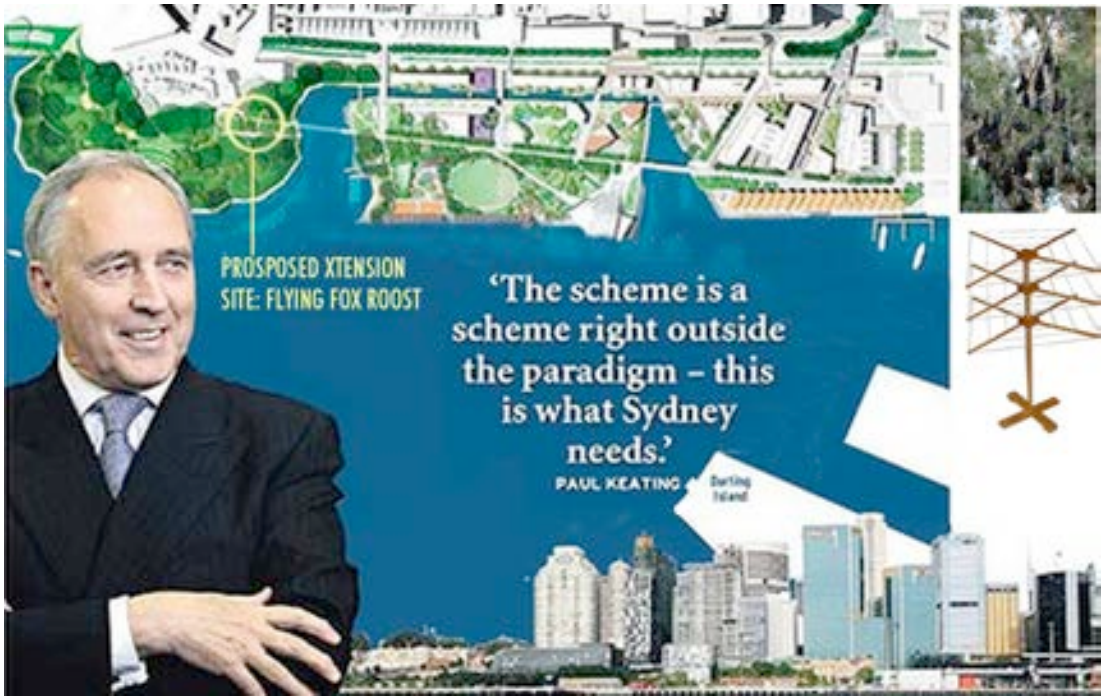

Figure 8: Re-imagined promotional graphic from the *Bat-Human Partnership*. Image credit: Tega Brain.

Whilst the proposed *Botanic Gardens X-Tension* may appear to operate in a similar way to *Biosphere 2* in that it presumes humans are able to recreate and reconstruct ecologies, the significant difference is that it imagines an open, iterative and relatively uncontrolled project, thereby asking: what would an institution that breaks from older management structures and embrace new connections be like? Would it be better equipped to handle contemporary environmental challenges? Of course a key problem with large scale centralised development projects such as those at Zetland, the Melbourne Docklands, Sydney Central and Barangaroo, is that the resultant environments are often highly controlled and over designed spaces with conventional designs often acknowledging cultural memory in the form of a public art commission for example; something that is typically obliged to be retrospective and conciliatory. Our contestation was that previous ecologies and histories should be considered as a central part of the design phase itself. *X-Tension* therefore trades the manicured lawns and sculptures typical of public parklands for a space that supports a radically different political landscape – one that is governed and shaped by humans and non-humans alike.

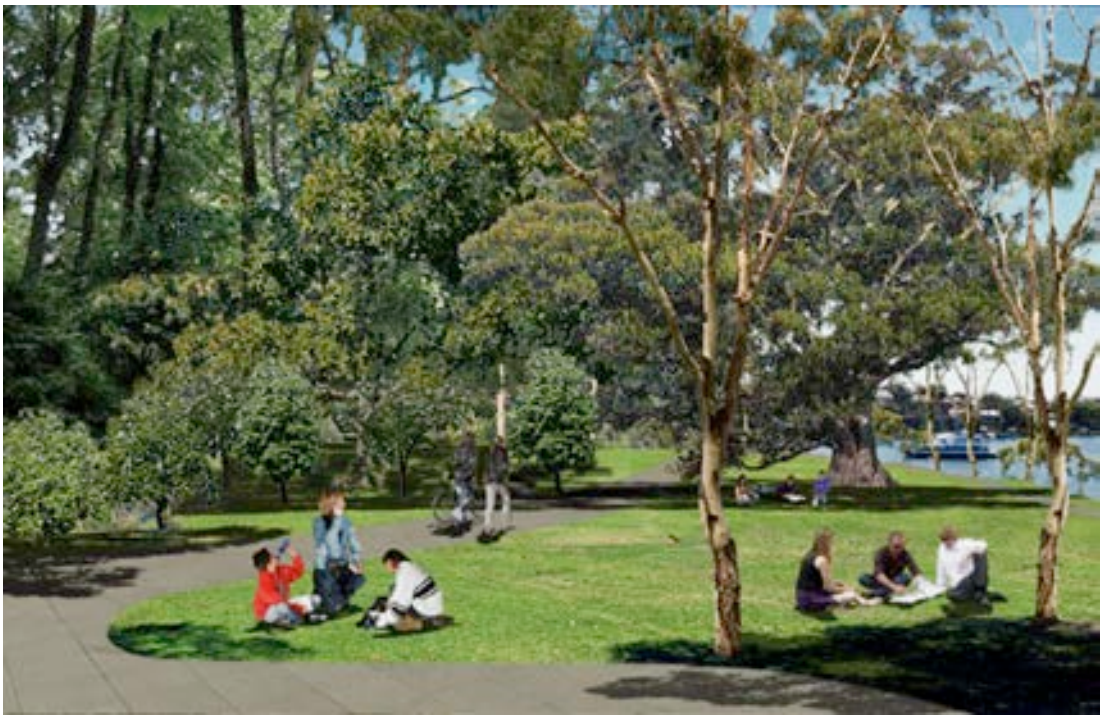

Figure 9: Re-imagined visualisation of *Barangaroo* parklands from the *Bat-Human Partnership.* Image credit: Tega Brain.

Figure 10: Re-imagined visualisation of Barangaroo shoreline from the *Bat-Human Partnership.* Image credit: Tega Brain.

2.5 THE POLLINATION SERVICE

Ecology is about entanglement and cross-species relationships across vast amounts of time. The *Human-Bat Partnership* highlights how both our livelihood and that of other species are enmeshed with the flying fox's. This web of connections and alliances, established on an evolutionary time scale, is being increasingly deformed by human influence.

2.5.1 Project Background

In the field of ecology, processes carried out by the flying fox such as pollination and seed dispersal are known as 'eco-system services' (Ree, North & Hsu 2009, p. 151). In an attempt to align conservation efforts and economics, much attention and research has been dedicated to addressing how to place a monetary value on these processes (Allsopp, Lange & Veldtman, 2008). What is the worth of water filtration performed by a wetland? What is the value of carrying out the pollination of *Myrtaceae* vegetation? Trying to use economic models and vocabulary to explain and communicate environmental systems is a highly restrictive way of understanding the complexity of one model through the complexity of one that is more familiar and privileged. The problem with comparative analysis in this way is that it transposes one complex model to another and in this process, both sets of complexity can become over-simplified. This idea is central to the field of environmental accounting (Boyd & Banzhaf, 2007) and is problematic as it is based on an assumption that we can adequately know and therefore quantify a complex system. This assumption was shown to be deeply problematic in the case of *Grasslands Biome*, amongst others (see chapter 1).

2.5.2 Project Description

The Pollination Service is a performative work that explores the concept of ecological value through an attempt to translate the activity and 'ecological services' of the flying fox into the domain of the human. For this work I dress in the style of a council street worker and hand pollinated the blossoms of several street trees in Sydney's CBD using a ladder, paintbrushes, a tool belt and glass jars. This action is featured in the *Bat-Human Partnership* video documentation and was carried out

again for a Sydney exhibition titled *A Stock Exchange*[37], where artists were invited to offer services to be traded in the absence of money. *A Stock Exchange* explored the abstract nature of value and currency and provided an important curatorial framing for *The Pollination Service*. Although manual pollination might initially seem abstract or even whimsical, it directly relates to real world problems. For example, in the Chinese province of Sichuan every spring villagers hand pollinate their orchards due to decimated bee populations (Boycott, 2010). Furthermore, as bee populations dwindle due to colony collapse worldwide, (Revkin, 2007) manual pollination is becoming more widely considered.

Figure 11: *The Pollination Service,* detail. Performed in Sydney, 2010. Image credit James Muller.

[37] This exhibition was programmed as a part of the *Imperial Panda Festiva*l, an annual showcase of art and performance held in Sydney.

Figure 12: *The Pollination Service*, detail. Performed in Sydney, 2010. Image credit James Muller.

In this work I question 'techno-fix' responses often mobilised in discussions of future environmental management and restoration strategies.[38] Belief in the 'techno-fix' is underpinned by the assumption that future technologies and practices can be developed to replace activities currently carried out by non-human processes. The pollination performances appropriate tactics of exaggeration, speculation and absurdity from Jeremijenko's practice. As such, they are intended to be provocative whilst also embracing the ridiculous, humorous and the playful. The performances thereby present a 'micro-dystopic' glimpse into a possible future where humanity has failed to value, support and adequately acknowledge the critical role other species play in maintaining our present quality of life. In this way, this work uses a dark humour as a strategy to engage the viewer with a warning of an undesirable future. Through this satire, it also refuses a romantic concept of nature as one that is pure, balanced and separate to us. Instead, the project directly focuses on how we are all profoundly entwined. Furthermore through the use of visual fiction, *The Pollination Service* capitalises on the aesthetic language of public institutions, thereby further critiquing the position taken by the *RBGT* towards their flying fox colony.

[38] This is exemplified through discussions of geoengineering (Hällström, 2008).

Figure 13: *The Pollination Service*, detail. Performed in Sydney, 2010. Image credit James Muller.

The projects discussed in this chapter, as well as those that follow attempt to break open relationships between humans and other species by exploring some of the tacit, black-boxed assumptions that lie within our interactions and perceptions of other living things. Just as *OOZ* critiques the institution of the zoo and celebrates cross-species interactions in public urban spaces, *The Bat-Human Partnership* rethinks the institution of a Botanic Garden and suggests a species-centric approach to urban development that appeals to the needs and desires of both humans and other species. Similarly, *The Pollination Service* performatively engages with systems of exchange between other species in an attempt to make invisible non-human processes explicit. Each work therefore engages speculative strategies to move towards the adoption of a more radical ecology of urban space.

Please refer to the following videos and accompanying images that are included on the disc before reading Chapter 3:

- *Oceans of Air – New Plymouth*, NZ, 2011. Duration: 4:55 minutes.
- *Oceans of Air – Sunshine Coast*, Qld, 2011. Duration: 1:43 minutes.
- *Kilowatt Hours Documentation*, 2011. Duration: 1:29 minutes.

All video files are included in .mov and .mp4 file formats. Please open .mov files with Quicktime and .mp4 files with other media players.

Chapter 3: Explicating Environments

> What if "Truth" in some very large and, for us, overriding sense is information not about what we perceive (the green leaves, the stones, that voice, that face) but about the process of perception?
>
> (Bateson, 1991, p. 227)

Through the experience of developing *The Human Bat Partnership* and *The Pollination Service* I began to see how ecology has been influenced by misleading ideas, which persist in environmental management today. The concept of nature as separate and idealised, the translation of ecosystems through machinic metaphors, and the capricious cultural value attributed to different species, are each barriers to developing a more productive understanding of ecology as an integrated and complex system.

These realisations led me to develop two new works, *Oceans of Air* (2011) and *Kilowatt Hours* (2011), which engage with the systems that support the biosphere. *Oceans of Air* was developed in collaboration with Spanish atmospheric scientist Ramon Guardans and Australian robotics artist Kirsty Boyle.[39] Mixing methodologies and processes from art and science, the work plays with the production of environmental knowledge. By using scientific and pseudo-scientific methods, it seeks to make air *visible,* rendering its material properties sensible, and rhetorically asking how we might act differently in our relationship to it. Similarly, *Kilowatt Hours* takes on an invisible yet fundamental facet of contemporary life: electrical energy systems. While electrical systems are pivotal to our daily lives, they are (for most of us) infrastructures we rarely critically engage.

Both these experiments in generating information are consciously pseudo-scientific. For this practice-led research project, pseudo-science therefore serves as a critical and creative strategy for engaging with scientific techniques and their claims to authenticity and accuracy. Instead of collecting data to falsify a theory or hypothesis, these creative works use data to draw attention to what is and is not

[39] Kirsty Boyle's artist website at http://www.onnai.com/about/. Retrieved May 1, 2012.

'measurable'. Thus, data is collected in order to construct and disseminate representations of our world that usually escape quotidian perception (for example, that air is weightless), operating on the principal that changing perception is a precursor to changing relations.

In this chapter I explore information visualisation practices of art and design in relationship with some of Natalie Jeremijenko's information visualisation projects. I also discuss the intersections of these creative practices with Gregory Bateson's (1991) analytical thinking on epistemology and Marshall McLuhan's (1964) now venerable doctrines on how new media technologies extend the body and the human psyche. In this context, I analyse the methods of collecting and visualising environmental information mobilised in *Oceans of Air* and *Kilowatt Hours.* This allows me to further address how creative practice can reflexively apply information derived from scientific methods to influence our cultural connection with environmental life-support systems.

3.1 VISUALISING ENVIRONMENTAL DATA: WHAT THE FROG'S ARDUINO TELLS THE FROG'S BRAIN[40]

> With the collision in the public imagination of the environmental climate destabilization and environmental concerns more generally, there is suddenly a utopian idea that we can use these new technologies and sensors and visualization techniques to address pervasive environmental issues with pervasive computation.[41]
>
> (Jeremijenko, 2008, p. 10)

In a contemporary context, knowledge is acquired through technologically mediated pathways. Much has been written about recent creative activities inspired by the availability of small affordable technologies and their potential for generating and visualising networked environmental data from all parts of the planet.[42] Yet

[40] This title references the famous paper *What the frog's eye tells the frog's brain* (Lettvin, Maturana, Mcculloch and Pitts, 1968).
[41] Tony Fry has also written about utopian ideals or the "power of dream" as driving forces in the making of the modern world. He argues that these ideals are also therefore, powerful "defuturing" agents (Fry, 1999, p. 129).
[42] For example the *Situated Technologies Pamphlets* published by the Architectural League of New York focus on the implications of ubiquitous technologies on architecture and urbanism. Issues 3, 4, 5 and 8 discuss how these technologies augment our ability to collect environmental data. These can all be accessed at: *Situated Technologies Pamphlets.* The

despite this rise of creative activity, there is still some debate about the efficacy of these practices. In conversation with Benjamin Bratton in *Situated Advocacy,* Jeremijenko (2008) critiques the oversupply of environmental information in art and design projects in recent years. Some of the better known examples of these practices are *Into the Air* by Nerea Calvillo (2008), *Flight Paths* by Aaron Koblin (2007) and the works later featured in books such as *Beautiful Visualization: Looking at Data through the Eyes of Experts* (2010). Jeremijenko (2008) specifically disputes their claim to the production of better knowledge of our environmental conditions arguing that designers and artists have typically failed to ask how the environmental information was collected, why particular datasets are privileged over others and therefore what ideologies might be reflected in these choices (p. 12). She argues that although these creative practices aim to provide a critical environmental discourse, they do not adequately interrogate the politics of their information production. This relates to the paradox of visualisation projects; although they aim to communicate information, if this is done uncritically, they concurrently obscure aspects of how and why this information was collected.

Similar issues are detailed by Robert Logan's (2010) discussion of media technologies in the computing age. Logan observes that historically there was less of a distinction between knowledge and information (p .80). Logan defines information as the meaning and context of data and knowledge as the "ability to use information strategically" (ibid, p. 80). He therefore argues that today's enormous availability of information makes the production of reflexive knowledge a critically important significant cultural challenge. Technologies such as the camera, the Internet, the smart phone and personal computer mediate events and information, translating them into language, articles, videos and Twitter streams that then get syndicated to appear on multifarious screens. Yet as Jeremijenko (2008) points out, these frenzied transfers of information do not necessarily involve reflexive engagements with the conditions through which the information was produced. Furthermore, they often do not address the potential application of data and therefore do not always equate to better knowledge production (p. 11).

Architectural League NY. Retrieved on February 17, 2012, from http://situatedtechnologies.net/.

Similarly as Marshall McLuhan (1964) argues, digital modes of information transfer also embody implicit biases:

> Our conventional response to all media, namely that it is how they are used that counts, is the numb stance of the technological idiot. For the 'content' of a medium is like the juicy piece of meat carried by the burglar to distract the watchdog of the mind…The effects of technology do not occur at the level of opinions or concepts, but alter sense ratios of patterns of perception steadily and without any resistance (p. 18).

McLuhan emphasises that the emergence of new technologies profoundly impacts epistemological processes, yet these technologies are typically received without criticality. Similar to McLuhan, Gregory Bateson (1991) considers epistemology, arguing there is no such thing as direct perception (pp. 225-229). He cites the seminal scientific paper by McCulloch et. al. (1968) called *What the Frog's Eyes tell the Frog's Brain* that Hayles (1999, p. 131) credits for initiating second order or the 'second wave' of cybernetics. Second order cybernetics in contrast to first order cybernetics takes into account the role and cognition of the observer within the system and therefore in the construction of reality. By comparison, first order cybernetics treats the observer as being neutrally located outside of the system. In McCulloch's paper, researchers demonstrate that a frog's vision is physiologically geared towards the identification of flies and they therefore show that perception is not only a cognitive process occurring within brain, but also a process embedded into the optical nerve itself. Bateson (1991) therefore argues our perceptive "machinery and processes of knowing simply constitute one enormous blind spot" (p. 226).[43] To extend this idea with McLuhan who views media technologies as an extension of our nervous system (Logan, 2010, p. 44), it is important to ask how profoundly these technologies shape processes of perception and therefore, knowledge making? How can a constituent criticality be built around these processes?

I argue that interdisciplinary creative practices can provide forums for this type of critical thinking, paralleling McLuhan's (1964) view that "art at its most significant is a Distant Early Warning System that can always be relied on to tell the

[43] This resonates with Latour's observation of the many processes that are subsumed into pre-givens during the unfolding and accumulative processes of scientific discovery. As discussed in Chapter 1, Latour (1987), uses the concept of the black box to describe processes that are taken as givens, for example, when using a microscope, we do not question the processes occurring within it.

old culture what is beginning to happen to it" (p. 22). Indeed, many of Jeremijenko's projects attempt to perform this 'service' by critically unpacking environmental knowledge production. The use of public and activist strategies facilitates her public engagement that extends beyond the safety and conventions of the art gallery.

Jeremijenko's work emulates a partial scientific methodology by setting up experiments such as 'testing' how a tadpole will respond to the quality of its water. Works such as *Keeping Tabs* (2008) casts a tadpole as a water pollutant sensor that translates water quality information and *Feral Robotic Dogs* (2003a) sees hacked toy dogs sniff out volatile substances at polluted urban sites. *One Tree(s)* pays homage to Beuys' *7000 Oaks*[44] (1982) by adopting this strategy to 'test' how genetically identical trees will grow in different environments. Planted in pairs across San Francisco Bay, these trees stand in for electronic sensors or networked computation devices that might instead collect and make sense of different environmental information. Another typical strategy of Jeremijenko's, and what differentiates *One Tree(s)* from a scientific experiment, is that the work is deliberately open-ended in its 'findings'. As such, the audience is challenged to synthesise the outcomes of this 'pseudo experiment' through interpreting the aesthetic differences of each tree as indicators of environmental and social difference. *One Tree(s)* thereby prompts viewers to compute environmental information for themselves in order to ask: Do the trees look different and, what might have caused these differences? The audience therefore becomes complicit in the production of environmental information, which restructures typical modes of expert driven environmental literacy.

One Tree(s) also sidesteps the historic nature/culture binary by strategically blurring conventionally drawn boundaries between the natural and the artificial. Being artificially cloned, the trees themselves confuse these categories. After planting, they also refuse to demarcate 'social' and 'environmental' factors that influence their growth. The success of a large tree could be attributed to it being in an affluent neighbourhood where council regularly waters street trees. However, it could also thrive because it has been planted in a position with full sun. In this way, the work achieves what scientific methods often fail to do; it makes information visible in its complexity, refusing reductive processes necessitated by scientific

[44] 7000 Oaks (1982) was a work by Joseph Beuys that saw the planting of seven thousand Oak trees in public spaces across Kassel (Germany), with each tree accompanied by a piece of basalt stone.

instrumentation. The problematic complexity of the collection and interpretation of information relates to a key paradox of information visualisation projects – that when invoked uncritically, they can act concurrently as processes of concealment. Much of Jeremijenko's work therefore returns to Bateson's questioning of the nature of truth, suggesting it is bound to the process of perception, that is, how we perceive and interpret information.

Jeremijenko therefore uses strategies of public information generation as she reveals her methodologies for the viewer but does not in turn impose strict findings. In this way, her work is differentiated from the information visualisation projects that she critiques as it consciously questions methods of data collection and examines how these processes result in information. It also asks who is able to carry out these processes by privileging non-expert forms of environmental investigation. These aspects of Jeremijenko's work have been influential to my own thinking in the projects *Oceans of Air* and *Kilowatt Hours* which also focus more on how data is collected rather than how it is visualised. Before I discuss these works, I will firstly consider two real world examples of disputes pertaining to who collects information because they generate an understanding around how such processes are inherently political.

3.2 THE POLITICAL SPACE OF ENVIRONMENTAL INFORMATION

Small, distributed technologies increasingly allow for 'non-expert' environmental information collection. Bratton and Jeremijenko (2008) argue that these technologies have the potential to reshape modes of participation within political structures so that "a new kind of political institutionality could emerge" (p. 12). However, they both also criticise the hubris of these technologies arguing that their use typically omits a critique of the "parameters of facticity" of information (ibid, p. 12). This resonates with the weakness of many art and design visualisations that assume information production to be both neutral and objective. Australian scholar Emily Potter (2009) identifies that these practices of environmental investigation and communication also assert a straightforward connection between information provision (or acquisition), an individual's awareness and collective action on a concern (p. 1). She argues that these connections are problematic because they assume the individual to be "the site of action," posited with the ability to shape government policy and inspire collective action (ibid, p. 1). Therefore, a complex

tension emerges between the perceived potential for these non-expert practices to foment environmental action and the very real political and social barriers that hinder progress towards better "ecological governance" (Bratton & Jeremijenko, 2008, p. 12).

Bratton's "new kind of political institutionality" (ibid, p. 12) is evident through citizen actions that emerged in the aftermath of the Fukushima nuclear emergency (March 2011), and the ongoing dispute between the Chinese Government and the US Embassy over air quality reporting in China in 2012. In light of the health threats caused by the release of large quantities of radioactive substances from Fukashima, and the apparent lack of information being released by the Japanese government, citizen concern grew rapidly. In direct response, hundreds of Japanese citizens deployed their own geiger counters and began publishing data on data brokering websites such as Safecast.org[45] and Pachube.com[46] (Plantin, 2011). This inspired other online parties to synthesise this data through numerous visualisations and Smart phone applications (Bordon, 2011). One of these, the *Wind from Fukushima* (2011), shows estimated levels of radiation across Japan[47] (ibid). These feeds and applications provided alternative sources of information to those available via mainstream Japanese media, which was rumoured to have censored any reports contradicting government media releases (Oi, 2012). Such citizen radiation data is persuasive for those whose health is at risk since individuals who are unrestricted by government or corporate agendas produce it. Of course, being citizen-generated means the data produced is uncorroborated, but with large enough quantities of data producers, trends can be identified and outliers disregarded. It is also valuable 'en masse' for comparison with officially collected data and the process is empowering because citizens become directly engaged with processes of environmental knowledge production.

These themes are reflected is a recent dispute in China concerning the official reporting of air quality in major cities, with controversy ignited by *The Chinese Air Pollution Index* smart phone application (2012). This app compares Chinese

[45] Available at http://blog.safecast.org/. Retrieved May 1, 2012.
[46] During the publication of this thesis, Pachube.com was renamed as cosm.com
[47] Although much of the documentation is published in Japanese, the application can be downloaded from https://play.google.com/store/apps/details?id=jp.gr.java_conf.seigo.stop_ra, retrieved on April 1, 2012.

Government air quality reports with those generated at weather stations in the US Embassies in Beijing, Guangzhao and Shanghai (Fresh Ideas Studio, 2012). It shows that the Chinese Government regularly reports significantly lower readings of pollution levels than the US Embassy. The Chinese Government has been criticised for interpreting their data to yield lower pollutant level information, (they also calculate levels based on the previous day's readings), and in response they claim the US embassy data is inaccurate as it is generated from only one data source rather than many (Tan, 2012). The Chinese Government has demanded that the US Embassy stop publishing air quality information, claiming that it goes against Chinese law and diplomatic convention (Lina, 2012). These disputes not only evidence the variability of how air quality information can be interpreted, but help reveal the very nature of institutional processes around environmental issues. These information practices allow a 'non-expert' to question the accuracy, and therefore the perceived honesty, of governmental sources. Both these examples highlight the naievety of uncritical data visualisation practices that do not engage with questions of how and why particular data sets have been collected. They also indicate a public appetite for data visualisations that engage critically with the political processes and biases through which information is generated and filtered, indicating how the production of environmental information is always at heart, political. It is not just a matter of 'reporting' on a static condition. Instead, representations of environmental information must actively interface with political processes and biases (Bratton & Jeremijenko, 2008, p. 12).

Yet an important question remains. How can sustained political or social change emerge from these new forms of information generation? Bratton and Jeremijenko (2008a) argue that the answer lies in understanding information as "new constitutional forms, yet to be formally ratified" (p. 2). Both *Oceans of Air* and *Kilowatt Hours* seek to open up related conversations by engaging with methods of environmental data visualisation and its foregrounding politics through understanding 'society' and 'environment' as intimately connected. They pursue this through humour, public spectacle and tactics of 'pseudo-science' that involve a mix of 'non-expert' information collection and visualisation processes.

3.3 OCEANS OF AIR AND THE GATHERING OF INSIGHT

3.3.1 Project Development

> We are all living at the bottom of an ocean of air. The atmosphere, from the boundary layer with the ground up through to the stratosphere is a 70 kilometre deep, dynamic ocean. Air masses and the substances carried within them travel globally in hours, days or weeks. As we breathe in and out, air is the medium that quite directly binds us all together.
>
> Reflections written by the artist team during *Oceans of Air*
>
> (Brain, Guardans & Boyle, 2011)

Oceans of Air focuses on processes of measuring and representing our Earth's atmosphere. This collaborative work was initiated at the third *ArtLab* residency[48] held as part of the *SCANZ 2011: Eco Sapiens* in New Plymouth, New Zealand in January 2011[49] and was continued at the *ArtLab* 2nd Satellite Lab Event (the Water-lab)[50] for the 2011 *Floating Land Festival*[51] held on Queensland's Sunshine Coast. The project was inspired by interactions with collaborating scientist Ramon Guardans, who for twenty years has been involved in international action on atmospheric and marine pollution.[52] The work began with attempts to measure the dynamic properties of the air, to predict air pathways and think through narratives of atmospheric investigation.

The *Oceans of Air* project uses processes of observation, data collection, performance, story telling, sampling and visualisation, to mix a variety of methodologies from both science and art. The outputs from these various methods of investigation were presented in an installation at the Devon Street Shopfront, New Plymouth (Figure 14) and in the two video works that document our air monitoring performances at each residency. [53] The first *Oceans of Air* video also includes Ramon

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[48] For information regarding this *ArtLab* visit: http://www.remnantartlab.com/lab-3/. Retrieved on April 1, 2012.
[49] The *SCANZ* Festival website is available here: http://www.intercreate.org/about-scanz/. Retrieved on April 5, 2012. This was also concurrently the third Art Lab Event.
[50] See http://www.remnantartlab.com/satellite-event-2-water-lab/, accessed on April 5, 2012.
[51] The *Floating Land* website is available here: http://floatingland.com.au/2011/.Retrieved on March 20th, 2012.
[52] During this time, he was a scientific advisor the *Stockholm Convention on Persistent Organic Pollutants* (POPs) and the *Arctic Monitoring and Assessment Program (AMAP).*
[53] *Oceans of Air* was also previewed during a public seminar at the Govett Brewster Gallery, New Plymouth, New Zealand on January 29th, 2011.

Guardans' recorded voice-over recounting stories of atmospheric discovery with an original score written and performed by Australian cellist Caddie Brain.

Figure 14: *Oceans of Air* installation detail, *Devon Street Shopfront*, New Plymouth 2011. Air samples and back trajectories. Image credit: Tega Brain.

3.3.2 Methods of Investigation

In order to examine processes of environmental knowledge making, we deliberately engaged in multiple methods of gathering atmospheric information. By juxtaposing each approach against the others we sought to illustrate differences, assumptions, cultural biases, gaps and perspectives implicit in the various methods. We actively sought to engage with the idea that there is no one-way of knowing, and that information production is always ultimately political and contextual.

To achieve this we deployed aerial sensors[54] to measure atmospheric properties like temperature and pressure. We did this as a series of public performances where we mounted sensors on balloons, and lifted them up into the atmosphere using fishing rods. This practice of collecting data was thus strategically blended with humour and absurdity as we fished upwards into highly visible public spaces, building upon Natalie Jeremijenko's frequent use of eccentric public spectacle as a

[54] These sensors were called *Seeeduino* microcontrollers that were the first of their kind made available from a manufacturer in China.

powerful strategy to engage audiences. In these *Oceans of Air* performances, audiences present in these public spaces frequently initiated conversations with us about our methods of investigation whilst the absurdity of these performances prompted them to question the scientific legitimacy of these (pseudo-scientific) collection techniques. These performances therefore provided the conditions to question expectations of what environmental measurement entails, how it presents a public face and who might or might not be the 'experts' doing it.

Figure 15: DIY Balloon Soundings – An Air Sampling Performance for *Oceans of Air,* New Plymouth, 2011. Image credit: Tega Brain.

Figure 16: DIY Balloon Soundings - Air Sampling Performance for *Oceans of Air* at the *Floating Land Festival*, Sunshine Coast (2011). Image credit: James Muller.

As a further element of this project, we took daily samples of air and stored them in sealed jam jars. We then calculated the pathways that these air masses had taken in the days before arriving onsite. These 'backward trajectories' make it possible to estimate the historic pathways of any air mass at any location in the world using an online Hysplit computer model[55] provided by National Ocean and Atmospheric Administration[56] (NOAA) ("National Ocean and Atmospheric Agency," 2012). This process can yield information about what the air may be carrying with it. For example if an air mass had passed over the ocean it would likely contain salt or if it had passed over an urban area it might contain various particulates and pollutants. We included these estimations as an example of 'expert' generated atmospheric data in order to bring this perspective of the atmosphere into this project. Figure 17 shows one of these pathway maps as calculated from the enormous and growing metalayer of free online environmental data. This incongruous

[55] This model is readily available online to any user and accesses data from huge meteorological databases and can calculate forecasts and back casts of the movement of air to and from every point on the globe for each hour of each day since 1970.
[56] NOAA is the United Stated government scientific agency that investigates oceans and atmosphere.

combination of domestic glassware and satellite weather data was used as a creative strategy to compare 'expert' and 'non-expert' driven processes, allowing us to critique the scientific detachment and neutrality implied by the maps by juxtaposing them with the tangible substances that they describe – the samples of air. We hoped thereby to remind the viewer that what the map describes is actually in the space all around them.

This inherent tension between the real and the represented exists not only within meteorology, but also in much contemporary life. Whether it is through Google street-view (2012), various online map services from companies such as Google or Bing, scientific visualisations or the ever-expanding realm of digital imagery, much of how we experience the contemporary world is now via digital representation. These conditions further the power and designing influence of the televisual (Fry, 1993) and continue to attribute authority to representations by making the tangible world a mere "object of recognition" (Mellick-Lopes, 2009, p. 12), something that Jeremijenko's work *One Tree(s)* (2000) specifically addresses. By interrogating this gap between the material world and its map, *Oceans of Air* explores what is lost and what is revealed through the intersection of reduction and representation.

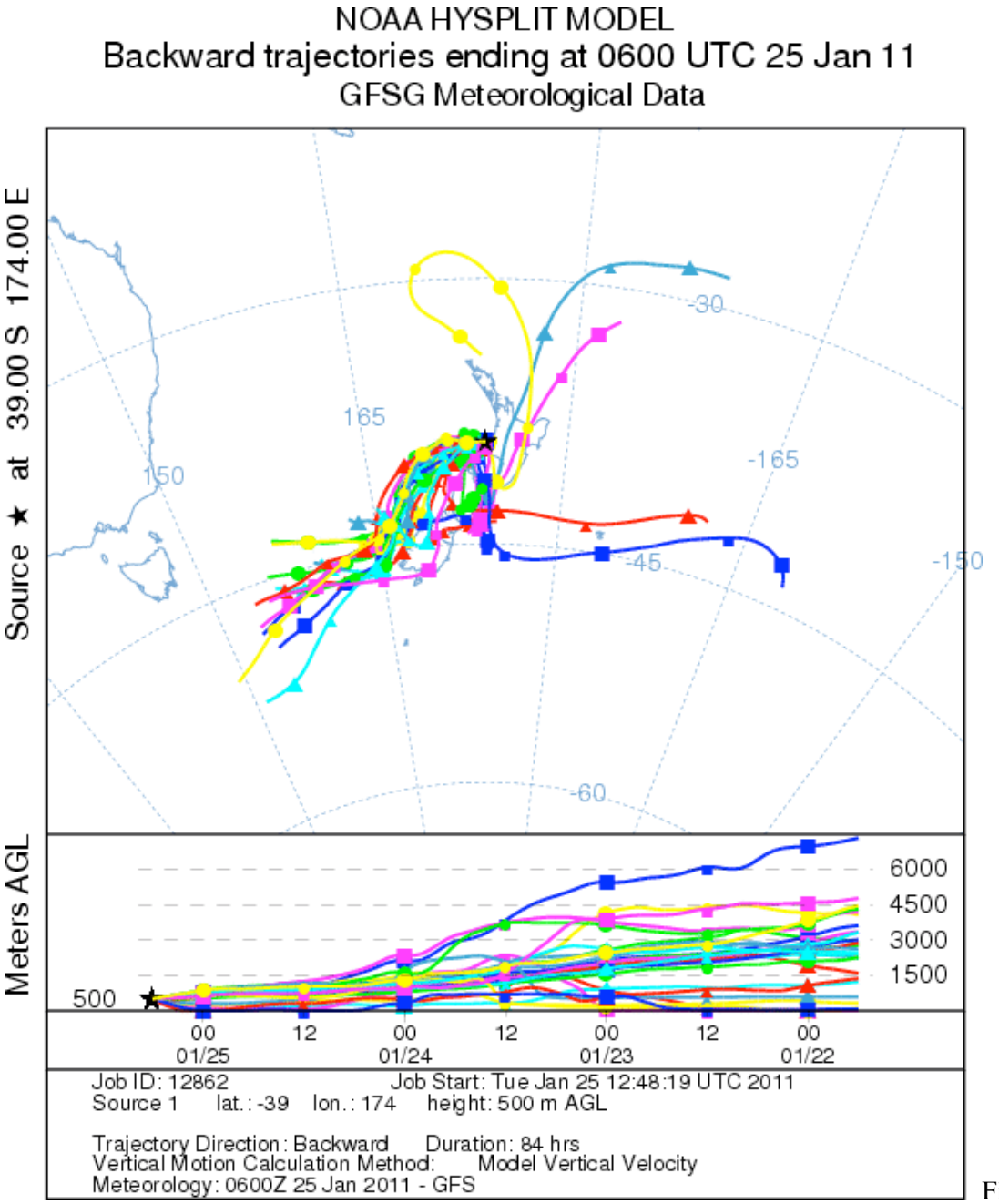

Figure 17: Back trajectories over 84 hours of the main air masses arriving in New Plymouth on the 25 of January, the lower panel displays the altitudinal displacement (National Ocean and Atmospheric Agency, 2012).

In order to further examine the cultural layerings of data visualisation we recorded Ramon's anecdotes of atmospheric history and edited them into the ultimate video work alongside footage of our 'fieldwork' performances. These narratives were used as a strategy for conveying information in a vastly different form to the numbers and figures generated through measurement. Ramon describes how

atmospheric connectivity was better understood with the advent of humanity's nuclear activities. Because air-born radioactive particles can usually only be attributed to one particular source, they were the first substance that allowed for the tracing of atmospheric pathways (similar methods are used in nuclear medicine, in which radio-isotopes are deployed to map circulation in the body). These observations provide good examples for Sloterdijk's (2007) argument that environmental awareness emerges out of its real or potential threat.[57] Sloterdijk's ideas are also echoed through the environmental knowledge production initiated by the Fukashima emergency and Chinese air quality debate.

I have since come to understand that this work suffered from a weakness associated with its context. Having been carried out at the Sunshine Coast and in New Zealand where there is relatively little perceived threat to the atmosphere, the work lacks the urgency and therefore mediagenic qualities of data stemming from sites such as Fukushima. In that sense the project ultimately lacked cogency to sustain an ongoing artistic development, and consequently a significant public response.[58] However, it did allow me to deepen my understanding of how artistic strategies like the adoption of 'pseudo' scientific methods can be used to stimulate public engagement around complex ecological relationships.

This thinking fed into my next cycle of creative practice. In particular, I was interested in further exploring the different roles of expert and non-expert driven environmental knowledge production, prompting questions such as, who is licensed to collect information and, what are the implications of how, where and why such collections are made? These questions therefore became the starting points for my subsequent project, *Kilowatt Hours*.

[57] Sloterdijk eloquently argues that mechanisms of terror have been fundamental to informing humanity's relationship to the environment (Sloterdijk, 2009, p. 107). The experience of terror is a kind of epistemological discovery, the revelation of a vulnerability that we had not previously imagined. Sloterdijk's processes of terror reveal the unexpected links that tie humans inextricably to their environment.

[58] I believe this failure of consequentiality also applies to Jeremijenko's more problematic works such as *Keeping Tabs*[58] (2008).

3.4 KILOWATT HOURS

3.4.1 Rationale

Kilowatt Hours is an artwork that presents 'non-expert' monitoring of the electricity usage of the work's exhibition space, visually interpreted in a projection beamed back into the space.[59] This installation work uses the public collection and visualisation of information as a participatory strategy for engaging audiences with the oft-invisible system of energy infrastructure. Through this project, I further explore the politics of environmental information and approach electricity infrastructure as a 'non-expert' by using DIY technologies.[60]

3.4.2 Project Description

Kilowatt Hours (Figure 18) draws on a legacy of experimental film, appropriating visual strategies from the 1973 Anthony McCall work, *Line Describing a Cone* (Godfrey & McCall, 2007). McCall's work involves a 16mm projection that begins with a single point of light and gradually draws a complete circle over the course of an hour. The work cleverly blurs boundaries between film and sculpture by constructing form with the 'immaterial' substances of light and smoke. In this way the projection no longer presents a two-dimensional representation of an arc on a wall but a rather three-dimensional cone in space. *Kilowatt Hours* is also a projection work, but is realised with more recent technology. It draws on the visual language of formalism to communicate energy information.

[59] It was presented at the 2011 *Expanded Architecture* exhibition held in Sydney. See Expanded Architecture Website. (2011) at http://expandedarchitecture.blogspot.com.au/2011/06/about.html, accessed 1 June, 2012.
[60] These included a current cost electricity meter, a laptop and custom software.

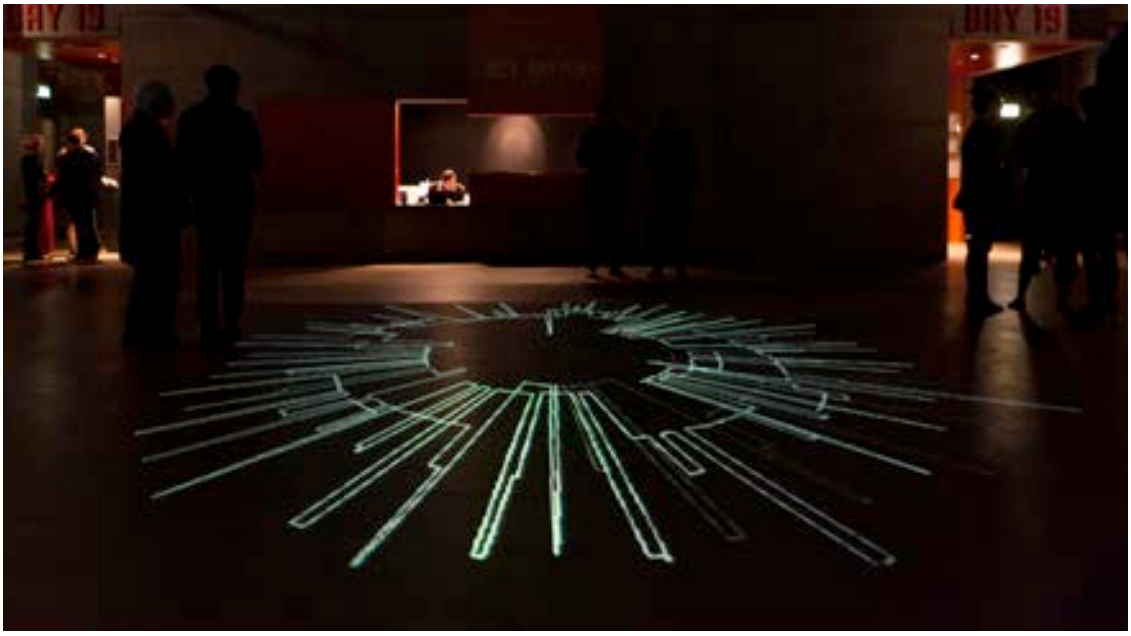

Figure 18: *Kilowatt Hours,* 2011. Image credit: Alex Wisser

Figure 19: *Kilowatt Hours,* 2011 Twitter feed. Screenshot retrieved on April 5, 2012 from http://twitter.com/tegabrain.

To create the work, I covertly installed an energy meter on the circuit board of the *Carriageworks* exhibition building in Sydney's Redfern, unbeknownst to the building managers. I wrote a software patch that automatically uploaded its readings to the websites Pachube[61] and Twitter.[62] I then accessed this published electricity data using Processing[63] and used the electricity reading to inform the size of the circle being drawn in the projection. As electricity use increased, the circle diameter became larger, and as in McCall's work, a 360-degree rotation has the duration of one hour.

In this way *Kilowatt Hours* allows the viewer to observe fluctuations in energy use over time and back through past hours. Just as McCall's work extends the medium of film into architectural space, *Kilowatt Hours* develops this further by

[61] *Pachube* (n.d.) is a web service that allows for real time data to be published online. At the time of writing this thesis had been renamed *Cosm*.com
[62] Electricity measurements were published to my twitter account (Twitter, n.d.).
[63] Processing (n.d.) is an open source software platform.

directly connecting with the dynamic systems of its surrounding architecture. In this sense the architecture and use of the gallery drive the work's appearance. *Kilowatt Hours* blends the formalist aesthetic of McCall's work with an activist agenda typical of much environmental art. It therefore plays into a long running dispute around art practices like formalism that position themselves as autonomous cultural activities that are not obliged to answer to anything beyond that of their own discourse.[64] Therefore, *Kilowatt Hours* deliberately holds a formalist and an activist agenda in uneasy tension in order to counteract the ahistorical naivety of many environmental art practices.[65]

3.4.3 Methods and Strategies.

By monitoring fluctuations in the invisible infrastructure of the exhibition space and placing this activity at centre stage, *Kilowatt Hours* attempts to explicate the unconscious ecological relationships that extend far beyond our immediate electricity usage. By dealing with the compiled energy footprint of public space, *Kilowatt Hours* visibly connects the viewers, the curators, the artists, the architecture, the building management, the energy provider, the grid and so on. In addition the work also makes direct connection with the all-pervasive and universal "matter of concern"[66] – climate change.

As Potter (2009) observes, the reality of climate change is located somewhere between "scepticism and prediction" and is impossible to represent as it is continually unfolding and emerging (p. 69). She therefore argues that creative practices dealing with this issue should set aside the impulse to obsessively unpack the distance between text (or image) and reality as it is an issue that is ultimately unrepresentable. Instead we should critique "the relationship between humans and the non-human environment that modes of representation assert" (ibid, p. 69). In

[64] In his 1974 assault upon these types of art practices in *Broadsheet,* republished in 2011, Brian Medlin describes formalist aesthetics as "a confused individualism scrambled together out of nihilism, elitism and hedonism" (p. 265).
[65] For a particularly scathing version of this line of critique see John McDonald's (2010) review of *In the Balance* as published in the Sydney Morning Herald.
[66] Latour (2004) favours describing the world through of "matters of concern" rather than "matters of fact" (p. 232). He sees facts as only partially describing the world. For Latour, a matter of concern is emergent, it assembles facts, values, perspectives, histories, objects and various actors to bring an issue into focus.

other words, we should critique the representation of ecology and therefore the politics, the assumptions and the hierarchies that are portrayed.

The deliberate use of abstraction deployed in *Kilowatt Hours* heeds Potter's warning and steps away from a preoccupation with the distance between the represented and the real. My 'pseudo scientific' methods focus upon augmenting *perceptions* of the hidden infrastructures rather than accurately investigating their precise activity. I also use abstraction in this work to obscure the quantitive details of the data driving the work. In reality it is impossible to tell exactly how much power the building is using. It is really only possibly to *compare* usage levels with what has gone before. I designed the work in this way to acknowledge the persistent concealment that occurs in visualisation works as discussed earlier in this chapter. Rather than assert this as an authoritative or representative diagram, I wanted to allude to the ambiguous and complex nature of gathering and visualising information.

Finally, in the context of this research project, this work serves as an important example of how media technologies have expanded the possibilities available to "make things public"[67] (Latour, 2005) by the 'non-expert, something that was witnessed in the aftermath of the Fukushima disaster. By using covert methods to install the work I wanted to further explore the implications of working in a public building and redirecting technological surveillance. By inverting the familiar relationships between the building and its observed occupants, I did not want to implicate the individual observer but rather the entire collective of human actors involved in the work. While it is often argued that collective change must be initiated by the behavioural change of the individual (Potter, 2009b, p. 3), this approach risks eliding adequate scrutiny of government and industry and fails to admit that our collective energy demand and energy production is far too complex to be dealt with simply at the level of any one individual's actions. In this way this work interrogates our interconnectedness with each other and with systems that sustain us.

[67] In the opening essay for the book, "From *Realpolitik* to *Dingpolitik: or How to Make Things Public"*, Latour (2005) discusses the need to "make things public" For Latour 'publicness' is about approaching non-humans as politicised things, and, in doing so it's also about pursuing equal philosophical significance for both human and non-human actors.

In this chapter I have expanded my research to consider the collection and dissemination of environmental information and played with these processes to examine environmental knowledge production. I have used an interdisciplinary mix of methods drawn from both art and science to actively experiment with how information is perceived and synthesised in culturally meaningful ways. More specifically, I have effectively tinkered with how technological processes increasingly shape and intervene in how we understand the invisible systems upon which we rely. Technology does not simply mediate how we understand our ecology; it is potently active in its making. In the next chapter I will continue to develop these ideas, through presentation and analysis of my final work, *Coin-Operated Wetland*. This installation explores how both processes of perception and synthesis of information can be applied to the design of water infrastructures.

Please refer to the following videos and accompanying images that are included on the enclosed disc before reading Chapter 4:

- *Coin-Operated Wetland*, 2011. Duration: 1:58 minutes.

All video files are included in .mov and .mp4 file formats. Please open .mov files with QuickTime and .mp4 files with other media players.

Chapter 4: Coin-Operated Wetland

> Designers, artists and philosophers are only asked to comment on infrastructure, not help build it.
>
> (Nold & van Kranenburg, 2011 p. 31)

Coin-Operated Wetland[68] is a large-scale interactive installation that brings together many key ideas, methods and strategies developed throughout this research. This work builds on my previous investigations into translating data into meaningful environmental information. It also signals a return to my concerns with water engineering, which formed part of the initial impetus for this research project. In this chapter, I will analyse the methods I used to reinterpret engineering processes through my creative practice. These methods allow larger tensions between managerial engineering and its ramifications for sustainability to be examined. I also claim the participatory structure of the artwork as a space through which to examine the need for better models for public participation in decisions concerning environmental risk management in society.

[68] *Coin-Operated Wetland* was exhibited at FirstdraftGallery in October 2011 and was produced as a part of the *Firstdraft* Studio program. This program aims to support emerging artists in Sydney.

Figure 20: *Coin-Operated Wetland* (2011), First Draft Gallery. Image credit Alex Davies.

Coin-Operated Wetland (see Figure 20) is best described as an experimental, autonomous water system. It is effectively designed as a coin-operated laundromat that is fused with a small-scale, functioning biological wetland. Throughout the exhibition any grey water produced by the washing machines gets filtered by the wetland, which, in turn removes particles and nutrients and returns the purified water back to the machines for subsequent reuse. For four dollars, the audience can wash their dirty clothes and be drawn into a complex set of relations with the many living and non-living actors of the system. The participant, the washing machines, a plethora of wetland organisms as well as soils and gravels all become connected through the common medium of water that circulates through the entire system.

This work builds on knowledge gleaned from my previous information-based projects, as well as from my analysis of Natalie Jeremijenko's central creative strategies. In particular, this work extends her methods of facilitating spaces for audiences to take on active roles in the production of a work. To this end, I create and present a system for use, rather than an intervention within a pre-existing system with the aim of positioning the audience as an active participant and making them complicit in the production and evolution of the work. In light of this, I leave the system to evolve throughout exhibition without interference from myself acting as

either artist or engineer. Rather than reflecting on the flaws in our present ecological relations, I want this project to actively offer a possibility for their reconfiguration.

4.1 WETLAND SYSTEMS AND WATER QUALITY

Wetlands play invaluable environmental roles in improving overall water quality in the hydrologic cycle.[69] They remove particles and nutrients from the water column through filtration via their plant root systems, soils and sands. Wetlands also act as a carbon sink since they sequester carbon from the air through the intrinsic metabolic qualities of their vegetation.

[69] The hydrologic cycle is a phrase used to describe the large scale water cycle that includes processes of precipitation, run off, infiltration, evaporation and so on.

Figure 21: Wetland detail, *Coin-Operated Wetland* (2011). Image credit Alex Davies.

As river catchments are developed into urban and semi-urban environments, what was once porous and pervious ground, becomes impervious (e.g. roads, rooves and pathways). This causes more water to flow through the catchment at faster speeds carrying oils, pollutants and nutrients with it. This drastically changes the hydrology of the catchment and in turn damages river systems by creating conditions erosion and algal blooms. Within the last decade in Australia, there have been wide spread attempts to re-establish vegetation systems in urban catchments to intercept stormwater flows and address these issues. Increasingly, catchment managers in local government are attempting to conserve and reinstate wetlands and riparian vegetation in order to treat urban stormwater before it reaches downstream river systems. *Coin-Operated Wetland* goes one step further and invites the wetland into a human domestic environment.

4.2 STATEGIES FOR THE PRODUCTION AND PERCEPTION OF INFORMATION

Coin-Operated Wetland has three main interconnected components, which are designed to facilitate the transfer of complex information. These are the laundromat, the wetland, and an area in the gallery where washing is displayed.

Firstly, the laundromat comprises of two washing machines arranged to more or less follow the design conventions of a typical laundromat. This familiarity was important, as I wanted the installation to facilitate conversation and interaction between participants. Secondly, the wetland is deliberately designed with transparent casing, water tanks, pipes and plumbing connections so that the water remains visible in the various stages of the system. In light of my previous exploration of information visualisation, this is an important design strategy to enable access to environmental information within the system. The quality of the water is revealed and exposed (to a certain extent) via its colour, transparency and appearance as it moves through the system. In these ways I deliberately avoid the system's processes being hidden and therefore unquestioned. By avoiding the creation of a 'black box' I increase the 'publicness' of the water, just as *Kilowatt Hours* achieves the same effect for electricity usage. This choice of materials literally enables the work to become a medium through which information can be gathered, allowing participants the capacity to make relatively informed decisions about usage.

Figure 22: Wash water detail, *Coin-Operated Wetland* (2011). Image credit Alex Davies.

Figure 23: Water detail in wetland, *Coin-Operated Wetland* (2011). Image credit Alex Davies.

The distribution of vegetation throughout the wetland is also designed to generate environmental information. In response to my previous consideration of information visualisation, I decided not to produce information about the *Coin-Operated Wetland*'s water quality via electronic water sensors and computational methods. Instead, I allowed the wetland plants to stand in for water sensors, arranging them with the hardiest species closest to the grey water input and the most sensitive species at the fresh water outlet. Any decline in the health of the more sensitive plants might therefore indicate a decline in quality of water leaving the system. As in natural wetlands, the plants are therefore an implicit informational viewport into the system's workings. As in Jeremijenko's *One Tree(s)* the audience can actively interpret the environmental health demonstrated by the work.

The third part of the installation, the washing line, furthers this 'testing' of water quality in an even more familiar way. On each day of exhibition, I washed a white item of clothing as an attempt to generate another form of information. Parodying the contemporary obsession with white washing as performed in advertisements for washing powders, each garment from each day was displayed in the gallery to demonstrate the daily water quality of the system. In this way, the question becomes not what is the nitrogen concentration of the water as it exits the wetland, but rather, what sort of water quality is adequate in this situation?

All of these decisions around how to generate environmental information also respond to the hubris of what Nold and van Kranenburg (2011) describe as the 'sensing planet' (p. 14). Akin to Bratton and Jeremijenko's (2008) discussion, they argue that the techno-utopian vision of covering the earth's surface with instruments generating vast quantities of environmental data overlooks questions around the relevance of this data and of how to translate it into locally meaningful information. I materialise a similar critique in *Coin-Operated Wetland* as I leave the water quality of the system open for assessment by the individual user through these non-instrumental methods. Whether the water appears adequately clean to use for laundry is something the users must decide for themselves. The 'success' of the system is determined from the perspectives of both the wetland plants inhabiting the work and the human users inspecting their washing.

4.3 INFRASTRUCTURE AND PARA-FUNCTIONALITY

> A good technology firmly related to human needs, cannot be one that has productivity as its supreme goal: it must rather, as in organic systems, seek to provide the right quantity of the right quality at the right time and the right place for the right purpose
>
> (Lewis Mumford 1961 cited by Jamison et al., 2011, p. 117)

Coin-Operated Wetland exhibits what Anthony Dunne (1999) describes as "para-functionality", which he defines as a form of design that is "within the realms of utility but attempts to go beyond conventional definitions of functionalism to include the poetic" (p. 44). My work serves as an "eccentric object" (ibid, p. 45) embodying cultural provocations that are otherwise difficult to achieve in commercial design or engineering. In *Coin-Operated Wetland* I use functionality in the way that Dunne (1999) suggests – as a strategy to critique the way our infrastructures currently define our actions and thereby explore other possibilities for how our systems could be designed (p. 45). As such, achieving the most efficient water treatment process is not the main prerogative of this designed system. Instead, the work is configured as a closed loop so that pollutants from the laundromat decay and became assimilated over time. Unlike in larger naturally occurring wetlands there was no flush out mechanism beyond the capacity of the wetland itself. Significantly, this means that there is no way to export waste to the 'outside' world like conventional wastewater management. Therefore the work challenges the notion of the 'environment' as external, outside and separate to us. This is particularly apparent on micro scale of the work where the distance between human upstream and environment downstream is condensed. As a result, it becomes pertinently clear that there is really no such thing waste 'disposal' in real ecological terms.

In these ways *Coin-Operated Wetland* asks the participant for compromise and partnership. The wetland requires water flows for its survival and so the human user is a critical part of the system. However, if they chose to over-exploit the system (by washing clothes many times per day with large amounts of soap) the system will most likely collapse as rapid downstream effects compromise the health of the plants. By actively engaging this tension between appropriate use and over-use, the work

becomes a metaphor for human impacts upon existing water systems[70]. In this installation the user is therefore prompted to consider the trade off between an intense wash and the visible health of the plant life. In wanting the wetland to survive, the work demands we adjust our expectations of the system's carrying capacity. This tension is alluded to in the washing instructions that accompany the system as can be seen in the photographic documentation of this work that accompanies this thesis. These instructions indicate to the participant that they must actively decide how best to use the system and that the service it provides is not infallible but rather, must be negotiated. The *Coin-Operated Wetland* therefore makes the connection between human action and environmental health explicit and tangible in the gallery context. In this way, washing one's smalls playfully casts the viewer in the role of a natural resource manager.

4.4 DESIGN AND PERCEPTIONS OF RISK

From an engineering perspective, the question of what is an acceptable level of risk is central to how policy and regulations are ultimately decided, and in turn, what then becomes materialised through design. Water engineers' roles are typically defined by their adherence to institutional guidelines in order to minimise risks to public health and safety. Coin-Operated Wetland is openly non-compliant with the NSW Health Guidelines that are enforced during the implementation of water re-use systems in residential situations (NSW Government, 2000). These regulations require grey water reuse systems such as this one, to have a tertiary stage of water treatment, a process that kills pathogens and bacteria through use of ultra violet light, reverse osmosis or chemical processes (Englande & Krenkel, 2004, pp. 369-670). These regulations are aimed at minimising risks to public health by catering for a worst-case use scenario for the system: the situation posing the highest level of risk – e.g. washing a full load of soiled nappies. (NSW Government, 2000, p. 5)

In the early stages of development I was reluctant to subvert these health guidelines, something indicative of the normative authority awarded to matters of health. Jeremijenko's practice emphasises this authoritative power by broadly co-

[70] The fate of the Murray Darling River is an example where the over-allocation and exploitation of a river system by humans has severely compromised it as habitat for humans and non-human organisms alike, leading to the deterioration of water quality and often resulting in exacerbated shortages and salinity (Goss, 2003).

opting the normative and universally accepted aims of health for environmental action (e.g. operating as the Environmental 'Health Clinic'). However throughout this research project I have come to understand that artistic strategies enable the freedom to work through different criteria that subvert or reconsider existing priorities of safety, optimisation or efficiency. By doing so, art can reflect on and throw these ideas into debate and contestation. Creative strategies such as 'para-functionality' and the flattening of traditional ontological hierarchies therefore give me licence to deliberately design systems that differ from those sanctioned. Therefore this wetland is slightly undersized and without a tertiary stage of water treatment – it ignores the 'worst case scenario' approach.

This 'worst-case approach' is central to the practice of engineering and reflects the very real threat to human life posed by potential failures (e.g. a bridge collapsing or contaminated drinking water). While risk minimisation has drastically improved many facets of Australian life, Latour and Harman's object orientated approach prompt us to ask how this approach has affected the plethora of non-humans. Risk minimisation has been crucial to human survival but it also poses contradictory outcomes that risk the survival of other systems on which we depend. As such, minimisation often implies *exporting* or *deferring* risk – something that asks us to make a subjective judgement between upstream and downstream, inside and outside, or human and non-human. This contradictory characteristic of risk is a central concern in *Coin-Operated Wetland*, which collapses the presumed distance between 'human' and 'environment' and throws into debate the choices we make when deciding between clean clothes or better water quality. As such, the work addresses this risk management problem and parallels Tony Fry's (2009) perspective argument for 'sustain-ability' (i.e. his work asks us to consider the impact of our present actions on the *ability* for future generations to *sustain* themselves).

In his influential book, *World Risk Society*, Ulrich Beck (1999) contributes considerable insight into the connections between information, knowledge and action in order to interrogate such risks. He argues that we live in a "world risk society" where the increasingly critical problem is how to make responsible decisions in the face of growing uncertainty, fuelled paradoxically by more information (Beck, 1999, p. 5). Beck describes this paradox through his concept of "manufactured uncertainty" which questions the central assumption of the Enlightenment: that better knowledge

will mean better decision-making. Beck argues that manufactured uncertainty "means a mélange of risk, more knowledge, more unawareness and reflexivity and therefore a new type of risk" (ibid, p. 112). The more information we acquire and the more technological development that this yields, the more uncertain we become of the consequences of these developments. Our technological progress occurs faster than our ability to culturally digest it.

In the last two decades of Sydney water management we can see real world examples of this 'mélange of risk'. The 1998 water crisis was initiated by Sydney Water's new testing process of the city's drinking water supply identifying a previously undetected pathogens (Healy, 2001). This new information lead them to declare the water unsafe, despite no other known changes in water management during that period. Arguably, the NSW government also co-opted manufactured uncertainty to rashly implement the Sydney water desalination plant at Kurnell[71] without transparent discussions or justification. Initially the plant was only to be built if dam-levels fell below a trigger point of 30% (Isler, Merson, Roser & Urban, 2010, p. 357). However, in the run up to the 2007 election and with levels only at 35%, the NSW State Government reframed the debate, claiming a need to 'drought proof' the city and proceeded to commence construction. Perceptions of risk around water availability were increased by the use of this language, which implied a crisis situation (ibid). This example demonstrates Beck's (1999) argument that 'manufactured uncertainty' can actually avert democratic processes and see the hasty and ill-considered implementation of large scale, expensive technologies. What isn't adequately emphasised in the public discussions around these examples is that over time, these large-scale technologies and infrastructures can in fact achieve *increased* levels of risk through increasing green house gas emissions.[72] In this way they demonstrate a deferral of risk.

Beck defines risk as "the perception of future consequences of human action" (or consequently inaction), and therefore also as "a cognitive map to colonise the future" (Beck, 1999, p. 3). Scientific efforts allow us to perceive the consequences of our actions with an increasing resolution, but this does not necessarily lead to

[71] The decision to "drought proof" Sydney is discussed in depth by Isler et.al. (2010).
[72] Benn & Dunphy (1999, p. 2) discuss the risk associated with distributed water infrastructure versus 'big engineering' solutions such as desalination plants.

increased knowledge and better decisions. Instead it paradoxically leads to more complex and challenging decision-making.[73] At the heart of this contradiction are questions of scope and scale. If risk is defined by perceptions of threat then it is inextricably connected to when an impact is predicted to occur. If the threat is thought to manifest beyond the time scale of our lifespan, such as with some climate change consequences, then it becomes difficult to engage with its relevance.[74]

These problems of perceiving environmental risk embody contradictions that also exist within *Coin-Operated Wetland*. Specifically because not all water quality information can be identified visually, it is impossible for the participant to fully interpret water quality in the system without specialist testing procedures. This reflects Beck's (1995) understanding of ecological risks as political phenomena that are not always within the range of human perception. For example we need an expert scientist to tell us if there are high levels of oestrogen in our water supplies, yet science is also complicit in the release of these substances. Therefore, processes of science that exasperate risks are also those upon which we depend to identify them. Tonkinwise (2012) argues that this demonstrates a need for a Post Normal Science (PMS), which Beck (1995) similarly identifies as a reflective science. These approaches to science ask for a public involvement in the development of the project's criteria, responding to questions like "What levels and type of risk are we prepared to live with?" (Toninwise, 2012, p. 4) In the case of the Kurnell desalination plant there is a strong case for better structures of participation concerning large-scale infrastructure developments. What levels of water security are we prepared to live with? This is a question that needs to be explored with input from both experts and non-experts.

In view of this, *Coin-Operated Wetland* seeks to open a conversation around what a participatory Post-Normal-Engineering might look like. Users are encouraged to consider their complicity in the production of risk and decide what levels of risk

[73] The use of 'expert' scientific analysis to inform policy is discussed as highly problematic in STS literature by authors such as Stirling (2005). Stirling observes the disconnect that emerges between the intrinsic uncertainty of post-positivist science versus the desire for certainty for justification of government policy positions.

[74] Arguably this is one of the reasons that climate change is so difficult to address: it operates on a time scale that extends beyond the range of immediate perception (i.e. the sun comes up and goes down, just like the day before).

are admissible. Through partaking in the system, they are prompted to critique, interpret and reflect upon its co-creation.

Reflecting on this project during its exhibition, I realised that this part of the work could have been emphasised to a greater extent. In an Australian context, we are conditioned to approach infrastructures with an expectation that they unconditionally serve all of our needs. A superficial inspection my work may charge it with the same fault. Its potential weakness is that it appears to be a straightforward 'solution'. This realisation has led me to a deeper understanding of the potential interdisciplinary practices can have in emphasising the uncertainties and inconsistencies imbedded in our designed interfaces.

Figure 24: White washing hung out to dry. Detail of white underpants washed on Day 5. *Coin-Operated Wetland* (2011). Image credit Alex Davies.

Figure 25: One white item was washed each consecutive day and hung next to each other. Therefore, this line of washing acts as an indicator of water quality. *Coin-Operated Wetland* (2011). Image credit Alex Davies.

Coin-Operated Wetland is ultimately a system that demands and incorporates self-reflection through audience participation. It is realised through what has emerged as the central methodology of my practice: the use of pseudo scientific and pseudo engineering methods for the productive critique of technical and instrumental processes. As a piece of pseudo engineering, *Coin-Operated Wetland* subverts existing design guidelines and thereby presents an alternative mode of coexistence between humans and wetlands. Through scripting audience participation in this work, the system becomes co-created by the users and the other non-humans who inhabited it. The work therefore has potential to start conversations around environmental risk management and the strategic decisions of assessing water quality. This merges with ideas of participatory environmental decision emerging in Post-Normative science.

Rather than authoring a system that uncritically fulfils human needs, *Coin-Operated Wetland* seeks to reconfigure the politics of a domestic water system and more immediately render the consequences of human behaviours visible. It therefore emphasises our ecological interconnectivity and offers an alternative perspective on how our ecological relationships can be restructured.

Conclusion

> The futures that we are wanting when we desire sustainability need to be seductively seeable, but they also must not neglect that not everything can be seen, that much will always remain to be revealed, to be interacted with, to surprise. Desires are conflictual; what we desire creates a tension, fear as well as yearning. Sustainability must be such a desire; neither patently bright nor monstrously dark, but precisely both.
>
> (Tonkinwise, 2012)

I began this project aiming to examine ecological issues that are historically associated with both science and engineering. I wanted to see what art could bring to the table of sustainability that instrumental methods of investigation arguably could not. The central methods I have developed and applied throughout this research project have been appropriated from the procedures and practices of technical disciplines, and repurposed for my poetic, critical and activist agenda. I have developed a method of pseudo science that blends art and science and uses strategies of humour, absurdity, visual fiction, information visualisation and scripted audience participation to prompt a reflexive engagement with ecological debates and paradoxes. The resultant creative outcomes of this research project question the politics of our infrastructures and tease out our interconnectedness with them. They emphasise our intimate dependence on often-overlooked systems, and therefore allude to a more radical envisioning of ecology. In these ways the *Bat-Human Partnership*, *The Pollination Service, Oceans of Air, Kilowatt Hours* and *Coin-Operated Wetland* have opened up and materialised new ways of imagining and meaningfully translating issues around ecology.

6.1 RETURNING TO MY RESEARCH FOCUS

Through my five creative projects I have developed a critical practice that seeks to consciously re-evaluate assumptions of scientific and engineering hubris. I have developed a model of environmental experimentation as art and I have co-opted the aesthetics and appearance of science and engineering to question assumptions

and misconceptions around their objectivity, their political neutrality and their supposed independence from culture.

The Human/Bat Partnership and *The Pollination Service* respond to questions that emerge from the proposed relocation of the Sydney flying fox colony by the *Royal Botanic Gardens*. These works question and problematise the garden's view of ecology as occurring in discrete categories within prescribed hierarchies. *The Human Bat Partnership* and the *Botanic Gardens X-Tension* both demonstrate an open-ended proposition, something that would later became an important strategy in my practice for dealing with the uncertainties around ecological discourse. Through collaborating with Natalie Jeremijenko, the project further developed my understanding of some of her key methods such as the creation of absurd public spectacle, playful experimentation and the scripting of audience participation in interpreting project outcomes.

I began to experiment with these strategies in *The Pollination Service* that questions how we value the ecological 'services' of other species. The absurd public performances enacted during this creative cycle adopt a dark humour to strategically engage the viewer with a warning of an undesirable future. Through this satire, the work refuses a romantic concept of nature as one that is pure, balanced and separate to us. Rather, it directly focuses on how we are all entwined. Furthermore through use of visual fiction, *The Pollination Service* capitalises on the aesthetic language of public institutions using it to further critique the position taken by the Royal Botanic Gardens towards their flying fox colony.

The works discussed in chapter 3, *Oceans of Air* and *Kilowatt Hours,* consider some of the political implications of 'non-expert', citizen-led environmental data collection. In dialogue with the recent air quality controversies in Japan and in China, they ask questions of how environmental information collection can be used to activate political participation and to contest centralised 'expert' driven models. These citizen led activities not only reveal environmental conditions, but also sharply illuminate the nature of the institutions that guide our actions.

Oceans of Air further extends my creative methods of humour, absurdity and performance to build broader platforms for reflexive public engagement with environmental information. *Kilowatt Hours* does this also, however through blending an appropriation of formalist aesthetics with activist DIY methods of information

production. Through experimenting with and reflecting on these strategies, this creative cycle allowed me to solidify my understandings of interdisciplinary methods and their potential for critique. *Kilowatt Hours* is a pointed example of my emerging understanding of the potential of pseudo-scientific methods and as such, demonstrates an experimentation with more nuanced aesthetic strategies in the context of public space. The fundamental contradiction of visual information practices – that they simultaneously reveal and conceal, becomes a productive site within my practice and is particularly emphasised by the formalist aesthetic of *Kilowatt Hours* that refused to render information explicitly.

Finally, *Coin-Operated Wetland* continues to explore and problematise environmental information pertaining to water. It is a truly interdisciplinary work and as such, is able to strongly engage with the hubris of engineering. It evidences a continuation of my pseudo approach where I use the tools of engineering to subvert the discipline. Through an embrace of "para-functionality" (Dunne, 1999, p. 44) the work questions the human centeredness of infrastructure and returns to questions around ecology, coexistence and relationships between humans and non-humans. *Coin-Operated Wetland* also demonstrates a progression in my practice towards an active and productive form of critique, rather than one that is reflective and less engaged. It also presents an alternative system rather than simply reflecting on pre-existing ones.

The instrumental orientation of commercial design and engineering, remain restricted by agendas of commerce, risk minimisation and efficiency. As such, they offer limited opportunities for reflexive processes that facilitate radical change from within. It is therefore through practices that operate outside of these domains, in the interdisciplinary periphery, that we can perhaps begin to sense alternative models for connecting the human and non-human – with an inherently different politics. Seen together, these five works therefore evidence these types of interdisciplinary processes and methods and probe how we understand ecology in contemporary contexts. Each work examines different aspects of the design of our systems of environmental information acquisition and of urban infrastructures. Through subversions of technology and engineering, they open up the ecological problems and paradoxes that characterise our contemporary moment. This pre-empts the question of how to then move this modality of critical art practice beyond both the

walls of the ‘gallery’ and the relatively limited art world audience, and back into the professions from which I once practiced (and beyond). How to imbue practices of engineering, environmental investigation and management with a similar criticality, remains a deeply challenging question and therefore a significant direction for future research.

These projects also intersect with a body of theory that examines paradigms and discourses underlying concepts of environment and nature. They allude to alternative ways of approaching our ecology where there is no perceived distance between the human world and ‘the environment’. Through humour, the absurd and the playful, my creative practice is able to inspire reflection and critique to illuminate problems in engaging ways. The ‘pseudo’ method of my practice has emerged as a rich strategy to engage audiences with technical disciplines and as a new way into the debates around our environmental interactions. I will now develop this approach into the future, as there are clearly rich opportunities for this type of exploration given the relative open-endedness of artistic practice.

These interdisciplinary practices open our thinking to other modes of being that might better inform our understandings of larger systems and phenomena such as climate change. In seeking to reframe and re-imagine contemporary ecological debates, they have the potential to reorientate perceptions of the world, and perhaps therefore, to inspire actions that might change it.

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